TECHNOLOGY DEPT

AMERICAN MACHINIST

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McGraw-Hill Publishing Company, Inc.

Publication office, 99-129 North Broadway, Albany, N. Y. Editorial and executive offices, 330 West 42nd Street, New York, N. Y. Branch offices: Chicago, 520 North Michigan Ave.; San Francisco, 68 Post Street; Aldwych House, Aldwych, London, W.C. 2; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Atlanta.

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VOLUME 85 — NUMBER 16

AMERICAN MACHINIST. Copyright 1941 by McGraw-Hill Publishing Co., Inc. Published every other Wednesday, price 35c a copy. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of Circulation, 330 West 42nd Street, New York, N. Y. Subscription rates — United States, Canada, Mexico and Central and South American countries $5.00 a year, $8.00 for two years, $10.00 for three years. All other countries $8.00 a year, $13.00 for two years, $16.00 for three years. Entered as second class matter, September 29, 1936, at Post Office, Albany, N. Y., under the act of March 3, 1879. Printed in U.S.A. Cable address: "McGrawhill, New York." Member of A.B.P. Member of A.B.C.

A McGRAW-HILL PUBLICATION

PRINTED IN U.S.A.

MAJOR ARTICLES

Surface Contour by Taper Sectioning.....*H. R. Nelson* 743
Adaptability of Alloy Steels.....*J. G. Magrath* 748
Work Clamping Devices.....*John G. Jergens* 750
Shop Shots 752

ARMAMENT SECTION

Building a Bomber..... 757
Conveyors Speed Plane Production.....*R. B. Parkhurst* 769

SHORT ARTICLES

Old Man Johnson and Who Makes What..*John R. Godfrey* 791

IDEAS FROM PRACTICAL MEN

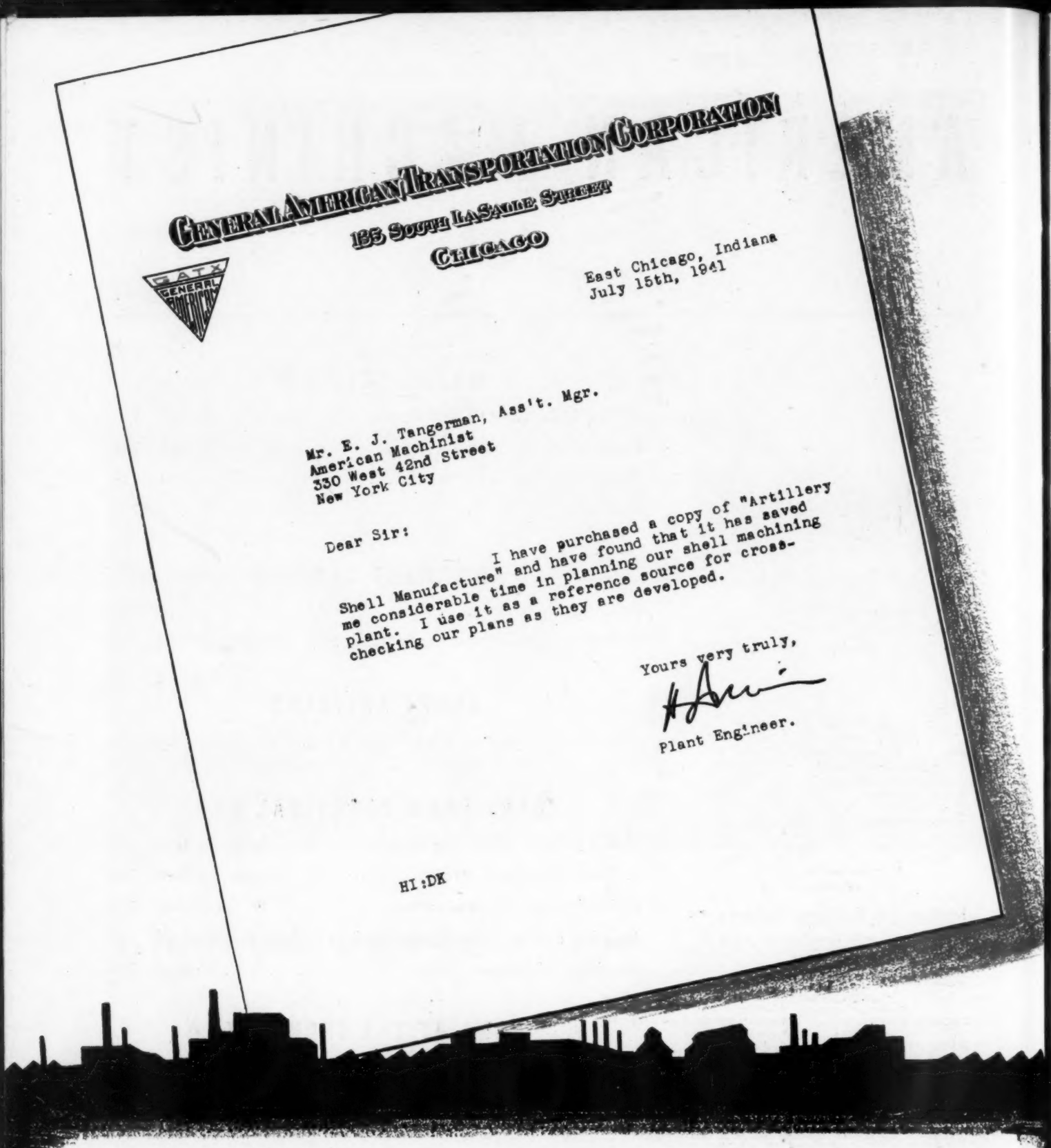
Heads Ground With Air Pump.....*Arthur Havens* 754
A Chuck for Bevel Pinions.....*Thomas O. Ford* 754
Guide Insures Straight Threads.....*W. E. Abbott* 755
Forming Eye on Close-Wound Springs...*John F. Cavanagh* 755
Punching Aluminum Disks.....*F. C. Hudson* 756

NEWS OF THE INDUSTRY

Gaging Business..... 776b
Inside Detroit..... 776g
Watching Washington. 776i
Names in the News... 776k
Plant Expansion..... 776k
Obituaries 776l

DEPARTMENTS

What's in This Issue.. 49
Reference Book Sheet.. 773
Editorial 776a
Shop Equipment News. 777
New Materials..... 787
Trade Publications.... 788
New Books..... 789
Seen and Heard..... 790



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East Chicago, Indiana
July 15th, 1941

Mr. E. J. Tangerman, Ass't. Mgr.
American Machinist
330 West 42nd Street
New York City

Dear Sir:

I have purchased a copy of "Artillery Shell Manufacture" and have found that it has saved me considerable time in planning our shell machining plant. I use it as a reference source for cross-checking our plans as they are developed.

Yours very truly,

Plant Engineer.

HI:DK

So that he who RUNS may read . . .

TODAY, you men who "run" metal-working plants are literally *running* to keep your jobs done. Your time is at a premium. Therefore, *American Machinist*, more than ever is presenting the technical information you vitally need in concise, quickly readable form. The Armament sections are typical. Here are further comments like Mr. Irwin's:

"In the case of our own plant, the *American Machinist* articles on shell production were very useful to our Works organization in the setting up of a shell-manufacturing department." —*V. A. Guebard, Acting Superintendent, Milwaukee Works, International Harvester Co.*

"Your articles on machining shell, now combined in 'Artillery Shell Manufacture', have given me a readily available and authoritative shell-making manual upon which to plan our own line. The section on 'Trench Mortars' was similarly useful."—*S. J. Matosec, Plant Engineer, Hammond Works, The Pullman-Standard Car Mfg. Co.*

"We are making a 37-mm. practice shell by an entirely new method, but we purchased a copy of 'Artillery Shell Manufacture' at the suggestion of Mr. Baumbach of the Rock Island Arsenal. It has proved helpful in comparing our methods with standard practice and in seeking out solutions for the little production 'bugs' that can cause real trouble on any new and unfamiliar job."—*E. A. Novak, Chief Engineer, Tuthill Pump Co.*

WHAT'S IN THIS ISSUE

R. E. PARKHURST

DR. H. R. NELSON

JOHN G. JERGENS

BUILD MORE BOMBERS

With the war in Europe nearing the end of its second year, the government has become more convinced than ever of the effectiveness of the bombing plane. That accounts for the increasing emphasis on the program to build more bombers. Naturally enough, the Glenn L. Martin Company, whose founder and president is credited with dropping the first bomb from an airplane, carries a big share of the job of supplying bombers to Great Britain and to our own military services. So new is this industry that problems arise every day for which there is no answer in old techniques. How some of these problems are solved is told in the feature story of our Armament Section, "Building a Bomber," which is to be found on page 743.

DOUBLE FEATURE

This time the Armament Section includes two stories, both of which deal with aircraft. The second part of the twin bill is devoted to a description of the manufacture of the Vultee training plane. Mechanical material handling has been carried further in this set-up than in other plants making airplanes. How this plant layout has resulted in boosting production is described by R. E. Parkhurst, chief industrial engineer, Vultee Aircraft, Inc. His story, "Conveyors Speed Plane Production," appears on page 769.

SURFACE STUDY

Gone are the days when industry asked for a good finish and was content to judge the results by a mere visual examination. Nowadays surfaces are accurately measured and literally taken apart in order to see the tiny hills and valleys which go to make them up. Dr. H. R. Nelson, Battelle Memorial Institute, has done considerable research on the subject under the sponsorship of the Norton Company. In an article on page 743, "Surface Contour by Taper Sectioning," Dr. Nelson describes his findings.

HOLD THAT WORK

Every machinist knows that the first step in turning out a good job is to clamp the work on the machine securely. For this purpose a wide variety of clamping mechanisms have been developed. Their design depends on the shape and size of the job and the number of pieces that are to be made. To give our readers a pictorial summary of work-clamping methods that can be used, we are showing a spread of sketches of typical clamping devices. John G. Jergens, Cleveland Pneumatic Tool Company, is the author. The first installment of "Work Clamping Devices" will be found on page 750.

MORE ON FLAME HARDENING

Continuing his systematic discussion of "Oxyacetylene Flame Hardening," J. G. McGrath, Air Reduction Company, in the fourth article of the series, tells of the effect of alloying elements in the steels used for flame hardening. Those who are following this series, will find this to be an important chapter in the development of the subject. See page 476.

PICTURES WITH A STORY

Someone once said that a picture is worth a thousand words. At any rate that is the reason for our "Shop Shots" which is an occasional feature of this paper. We collect useful shop ideas that can best be told by a good picture with a minimum amount of descriptive matter. A group of these appears on page 752.

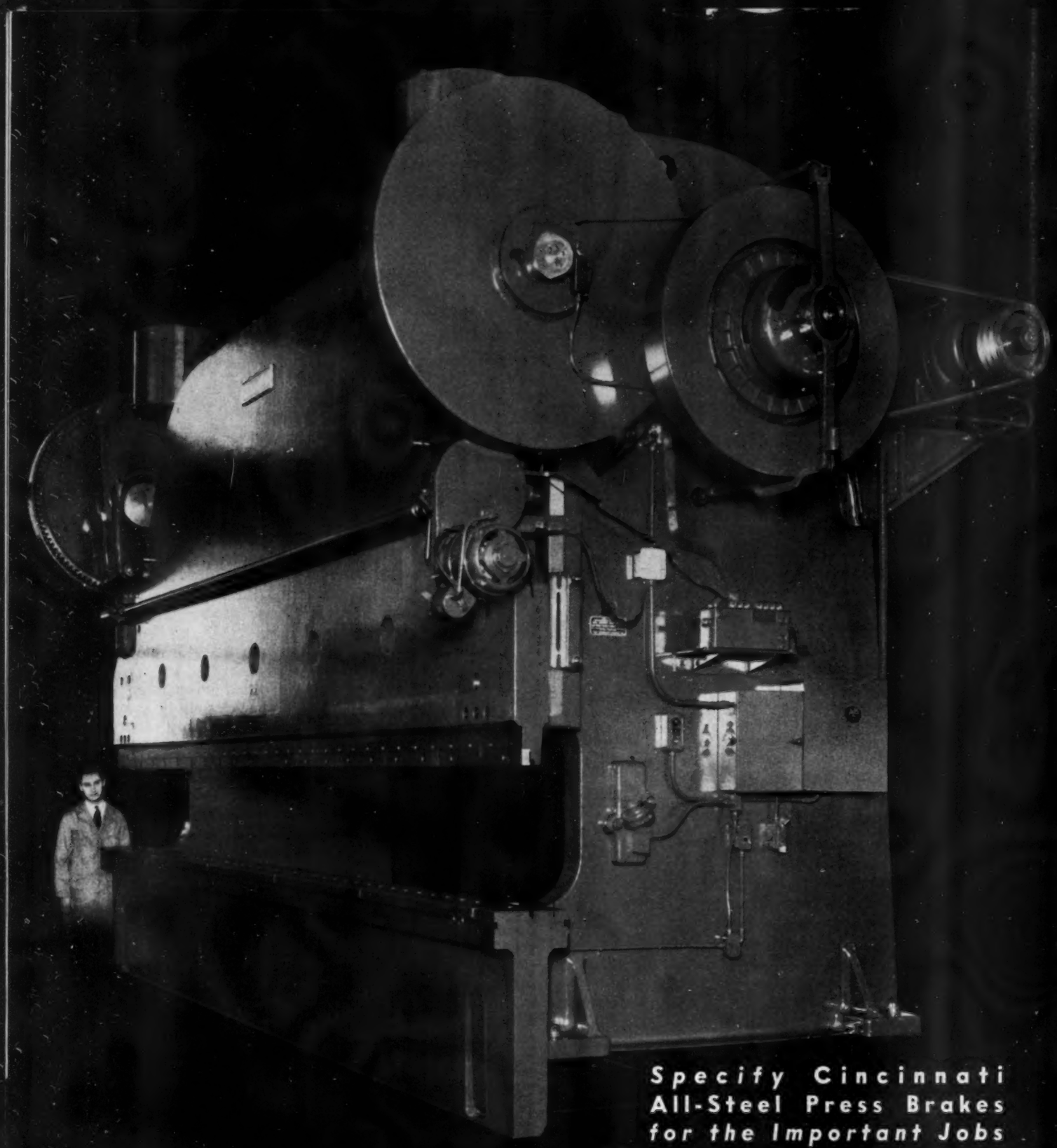
TIPS AND SHANKS

Users of carbide tools have learned that precaution No. 1 is to use a tip of proper size. Precaution No. 2 is to mount the tip on a shank that will hold it rigidly. This means sturdy tips and shanks, of course, but exactly how big should they be? Paul H. Miller, Carboloy Company, answers these questions in a pair of nomograph charts. See pages 773 and 775.

COMING

We have said a good deal about training programs in these pages, because we have felt it to be one of industry's first problems. But we don't think that the last word has been said yet, or will ever be for that matter, as long as changing conditions call for new ways of training men. The aircraft industry has a unique problem in creating a supply of skilled men. In our next number, George B. Fuller, director of training, Bell Aircraft Corporation, will tell of his company's program. Those of you still in need of able workmen will want to know how Bell met the task of increasing its force from 1,500 to 7,500 men in one year.

As quantities increase in mass production, the job of gaging each part becomes more burdensome. In fact, with so much automatic machinery used in manufacture, the point has been reached in many instances where the time spent on gaging a part may exceed that consumed in making it. The logical answer is automatic gaging. Probably the chief proponent of the process is the Ford Motor Company. Ford's accomplishments in this direction will be another of the many outstanding features of our next issue.



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ESTABLISHED 1877 AMERICAN MACHINIST BURNHAM FINNEY, Editor

Surface Contour by Taper Sectioning

BY H. R. NELSON, BATTELLE MEMORIAL INSTITUTE

Here is a method of studying surface quality which gives an exaggerated view of the finish in order to demonstrate clearly differences between surfaces

TAPER SECTIONING provides a useful means of studying the surface contour of metals. It is not an inspection method because it destroys the surface examined; neither will it replace the much more rapid tracer point methods. It does, however, reveal features not shown by other methods and provides a useful check on their accuracy. The principal advantage of the taper section over the ordinary normal section is that it provides, at ordinary micrographic magnifications, a record of a sample large enough to be representative. The smallest scratch depth which can be resolved by the method appears to be about 10 micro-inches, actual peak-to-valley distance.

If a ground surface is cut along a plane making a small angle with the plane of the surface and with the direction of slope parallel to the scratch direction, the plane of the section will intersect the surface in a contour which gives an apparent magnification of of scratch depth. It is easily seen from Fig. 2 that for small angles of taper the magnification is:

$$M = \frac{L}{H} = \cot \alpha \text{ approximately,}$$

where H is the scratch depth, L is the length of its projection on the plane of section, and α is thet angle of taper. In our work we have found it convenient to use a taper angle of 2 deg. 17 min. which gives a magnification of 25.

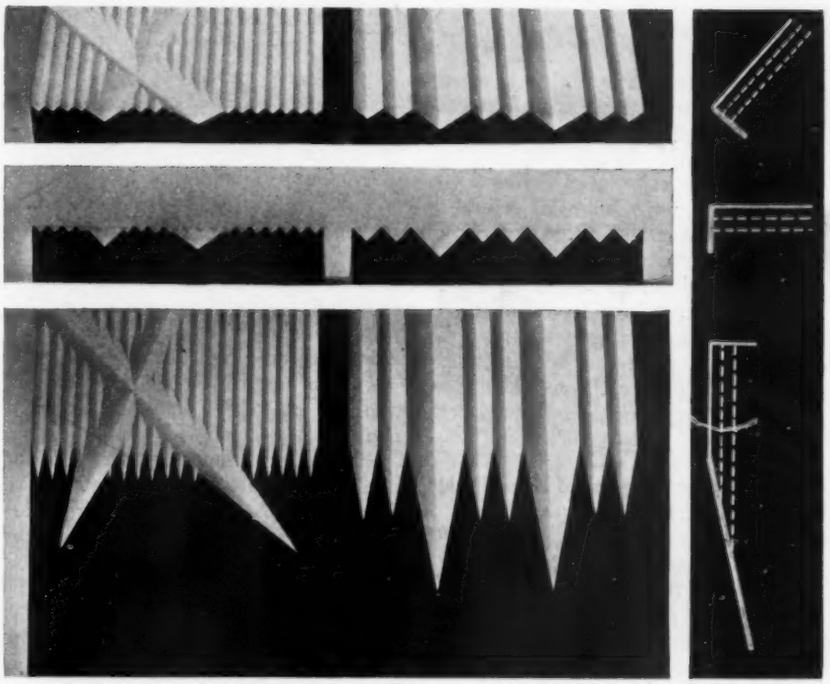


Fig. 1—How surface scratches may be magnified by taper sectioning is shown by different views of a solid model. At the top is a 45-deg. corner view, at the center is a normal view of the section and at the bottom is a taper section to give a 5× vertical magnification

In practice it is necessary to support the surface to be sectioned with an adherent coating which will prevent smearing the contour during the sectioning operation. For steel surfaces, a nickel plate about 0.025 in. thick is satisfactory. With flat surfaces, the back of the specimen is ground accurately parallel with the test surface and is covered with a stop-off during plating in order to have a reference surface for subsequent grinding of the taper. The specimens are then mounted on a plate having a taper of 0.040 in. per in. and ground on a surface grinder until the newly ground section extends across the whole upper face and the steel-nickel interface cuts across the section near its center (see Fig. 3).

With cylindrical surfaces a small section is cut out as shown in Fig. 3. The

Note: The present technique was developed as part of an investigation of surface finishes sponsored by Norton Company.

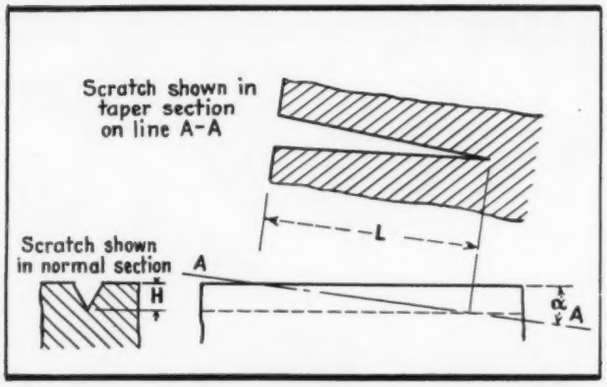


Fig. 2—A projected view of a surface scratch indicates the way in which its depth is apparently lengthened by passing a plane through the surface at a slight angle with it

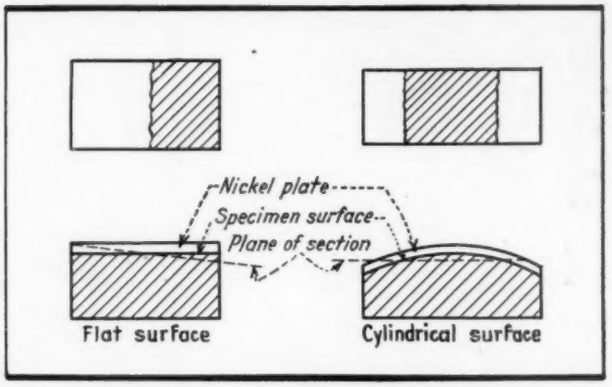


Fig. 3—To preserve the original surface when the section is cut it is necessary to preserve the contours by plating. Both flat and cylindrical surfaces are shown

bottom surface is ground flat and should be accurately parallel to the cylindrical axis. After nickel plating, the specimen is mounted directly on the magnetic chuck of a surface grinder and a flat ground through the nickel plate with a vertical feed of 0.001 in. As soon as the base metal is reached, further grinding proceeds with a vertical feed of 0.0002 in. until a predetermined chord length is reached. Working with cylinders two inches in diameter, we have found it desirable to stop the grinding when the chord length is approximately 0.050 in. and finish the sectioning by hand. If a predetermined magnification is to be obtained, one must end up with the right chord length after the final metallographic polish since the magnification is:

$$M = \frac{D}{C}$$

where D is the diameter of the cylinder and C is the chord length. For two 2-in. cylinders a chord length of 0.080 in. gives a magnification of 25.

Following the grinding operation, the specimens are polished by hand on successively finer grades of abrasive paper and are given a final metallographic polish without etching. In order to give contrast, the specimen is lightly heat tinted which darkens the steel but leaves the nickel bright.

Plating Precautions

Considerable attention has been given the plating conditions which, however, have been found to be less critical than was expected. It is probable that ordinary commercial practice in cleaning and plating will give satisfactory results. The nickel plating process must obviously satisfy the following conditions: (1) Neither the prior cleaning treatment nor the plating bath should etch the surface appreciably. (2) The nickel plate must have good adherence. (3) The hardness of the nickel plate must not differ too greatly from that of the underlying steel.

Specimens were cleaned in acetone and were then given a short cathodic treatment at a current density of 30 amps. per sq. ft. in a bath containing 30 gm. sodium metasilicate, 8 gm. sodium hydroxide and 0.25 gm. rosin per liter of water. They were then given a brief rinse in citric acid and immediately placed in the plating bath with the current on in order to prevent etching by the acid bath. Citric acid was used instead of the usual HCl rinse to eliminate the possibility of etching the surface but further tests with the SAE 6150 steel specimens have shown that a 5 to 10 sec. rinse in 0.1 N HCl produces no detectible change in contour and is likely to give better adherence of the nickel.

Plating conditions must vary with the nature and hardness of the test metal. For the SAE 6150 steel with a hardness of Rockwell C40, the well-known Watts bath has given good results at 112 F., pH 2.5 and 50 amp. per sq. ft. This gives a plate whose hardness is Rockwell C24 (converted from the Vickers scale). Sections with plates as soft as this are identical with others on which the hardness of the nickel approached that of the steel. In a few cases brittle plates were encountered when attempts were made to match the hardness of the steel. If a light or dark line appears along the contour interface on either the steel or nickel, the section should be regarded with a certain degree of suspicion.

Preparation of Photomicrographs

Photomicrographs of taper sections of SAE 6150 steel specimens heat-treated to a Rockwell hardness of about C42, having different types of finish, are given in Figs. 4 to 13. All grinding and abrasive finishing operations were done at Norton Company on commercial machines operating under carefully controlled conditions; great care was taken to preserve the surfaces in the condition prevailing at the completion of the finishing operation. Although the specimens were experimental pieces made for test purposes, attempts were made to produce representative types of commercial finishes.

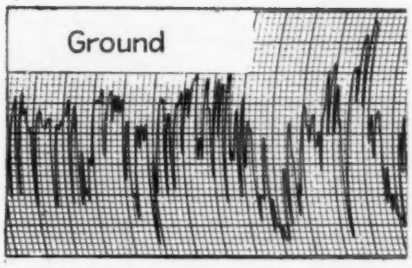
In all cases the vertical magnification due to taper is 25 and the photomicrograph magnification is 100×. As a result, the vertical magnification is 2500×, while the horizontal is only 100×. A black line ruled vertically across a number of the sections near the left end represents 100 micro-inches.

For comparison purposes, plan photomicrographs and Brush Analyzer curves are given. The plan photomicrographs were made with vertical illumination at a uniform magnification of 100×. The analyzer curves are reproduced with a horizontal magnification of 100× and a vertical magnification of 25,000×. Each small vertical division represents two micro-inches of vertical displacement.

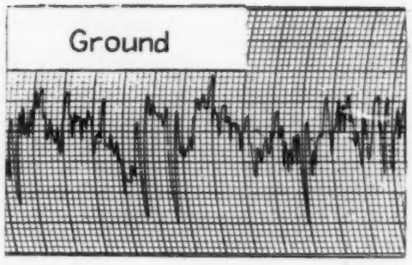
Comparison of Profiles

All the photographs may be directly compared in the horizontal direction, but the vertical magnification of the Brush analyzer curves is ten times that of the taper sections. Although many of the analyzer curves are from the same piece that was used for the taper section, they are never from exactly the same area. Consequently any apparent correspondence between peaks or valleys in the two profiles is entirely fortuitous.

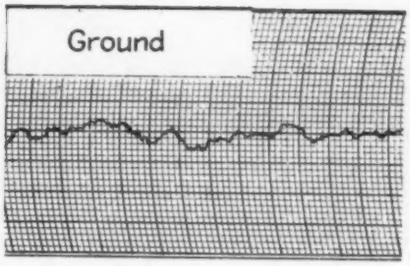
The h_{max} values for the taper sections were obtained by drawing two lines across each photomicrograph, the one being an approximate average of two or three high points on the surface, and the other being a similar average of



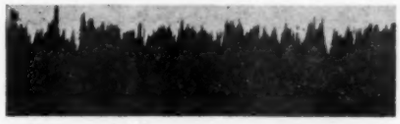
Brush surface analyzer curve. Magnification: Vert. × 25,000; Horiz. × 100



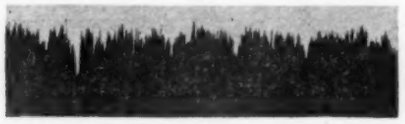
Brush surface analyzer curve. Magnification: Vert × 25,000; Horiz. × 100.



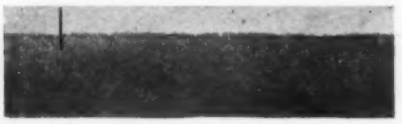
Brush surface analyzer curve. Magnification: Vert. × 25,000; Horiz. × 100



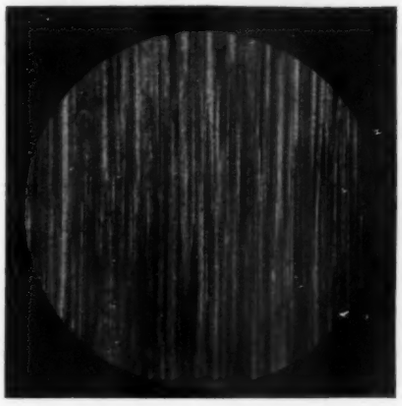
Taper section. Magnification: Vert. × 2,500; Horiz. × 100
(Black vertical line = 100 microinches)



Taper section. Magnification: Vert. × 2,500; Horiz. × 100.



Taper section. Magnification: Vert. × 2,500; Horiz. × 100
(Black vertical line = 100 microinches)



Photomicrograph
Magnification: Vert. × 100; Horiz. × 100

Fig. 4—Cylindrical surface wet ground with a 3846 K5B Alundum vitrified wheel.

Profilometer ..... 12 mu in., rms.
h_{max} Brush analyzer..... 72 mu in., actual*
h_{max} taper section..... 85 mu in., actual*

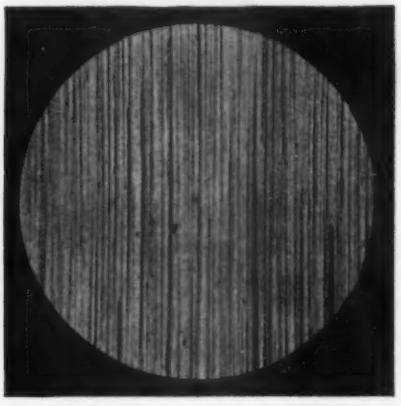
Removed about 0.010 in. from rough ground prior surface of roughness 30 mu in., rms.

Photomicrograph
Magnification: Vert. × 100; Horiz. × 100

Fig. 5—Cylindrical surface wet ground with a 3880 J8BE Alundum vitrified wheel.

Profilometer ..... 6 mu in., rms.
h_{max} Brush analyzer..... 50 mu in., actual
h_{max} taper section..... 85 mu in., actual

Removed 0.0011 in. from ground prior surface of roughness about 15 mu in., rms.



Photomicrograph
Magnification: Vert. × 100; Horiz. × 100

Fig. 6—Cylindrical surface wet ground with a 37500 H9L Crystolon shellac bonded wheel.

Profilometer ..... 1.6 mu in., rms.
h_{max} Brush analyzer..... 10 mu in., actual
h_{max} taper section..... 15 mu in., actual

Removed 0.0004 in. from ground prior surface of roughness about 9 mu in., rms.

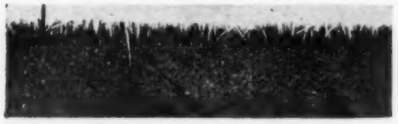
*"Actual" is added only for the purpose of emphasizing the distinction between root-mean-square microinches and microinches measured directly from the curves or sections.

two or three low points. This seemed to be the best way to get a representative figure for h_{max} from the taper sections to use for comparison with the recorded h_{max} from the Brush curves, and with the profilometer root-mean-square roughness.

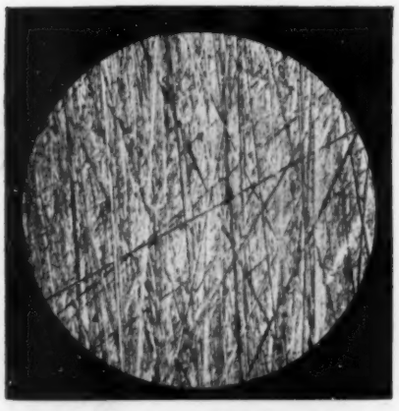
Any profile in which the vertical magnification is much larger than the horizontal tends to give an exaggerated impression of the surface roughness. One would have to stretch the taper profiles 25 times and the analyzer curves 250 times their length in order to have the true surface contour which then would look surprisingly smooth. The use of a large ratio of vertical to horizontal magnification in tracer point curves as well as in taper sections is principally a matter of convenience rather than a desire to emphasize the vertical components of the profile. Vertical magnifications must be of the order of 2000 in order to bring out the details of most surfaces. Consequently the record becomes unduly long if the vertical and horizontal magnifications are made the same. An important advantage of the taper section over the normal section is that a representative sample can be obtained without taking a long series of photomicrographs.

The general interpretation of the taper sections should not be considered as a simple magnification of the surface roughness, since this leads to difficulties on many surfaces. Fig. 7 shows inclined scratches which, at first thought, seem to undercut the surface. Actually they are merely ordinary scratches which are not parallel to the direction of slope of the taper section (see Fig. 1). On any surface which has random scratch directions, such inclined scratches will be encountered

Brush surface analyzer curve. Magnification: Vert. × 25,000; Horiz. × 100



Taper section. Magnification: Vert. × 2,500; Horiz. × 100 (Black vertical line = 100 microinches)

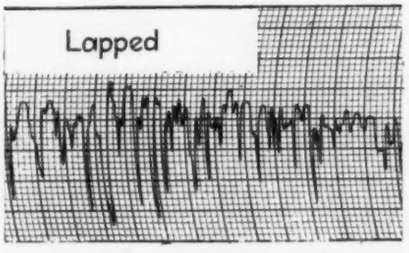


Photomicrograph
Magnification: Vert. × 100; Horiz. × 100

Fig. 7—Flat surface lapped with No. 600 Alundum. U. S. Products vehicle on cast iron laps for five minutes at 17 p.s.i., then two minutes with laps wet with gasoline.

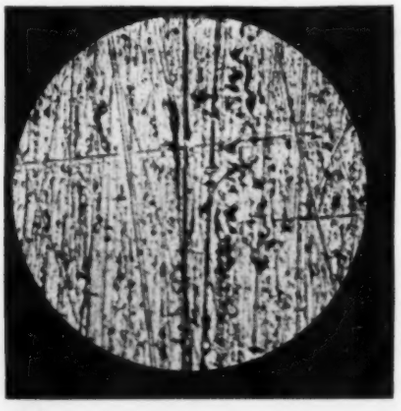
Profilometer	3 mu in., rms.
h_{max} Brush analyzer	30 mu in., actual
h_{max} taper section	50 mu in., actual

Removed 0.0004 in. from ground prior surface of roughness 4 mu in., rms.



Brush surface analyzer curve. Magnification: Vert. × 25,000; Horiz. × 100

Taper section. Magnification: Vert. × 2,500; Horiz. × 100
(Black vertical line = 100 microinches)

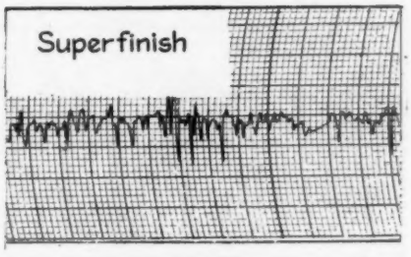


Photomicrograph
Magnification: Vert. × 100; Horiz. × 100

Fig. 8—Cylindrical surface lapped with a commercial lapping compound with a cast iron ring lap. The result is not considered a satisfactory or typical finish, but the section is of interest because it shows an unusual spalled type of surface.

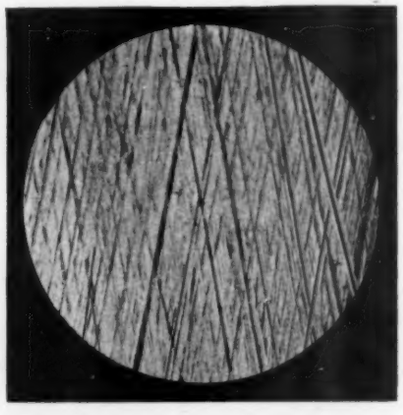
Profilometer	5-6 mu in., rms.
h_{max} Brush analyzer	48 mu in., actual
h_{max} taper section	90 mu in., actual

Removed 0.0004 in. from ground prior surface of roughness 5 mu in., rms.



Brush surface analyzer curve. Magnification: Vert. × 25,000; Horiz. × 100

Taper section. Magnification: Vert. × 2,500; Horiz. × 100
(Black vertical line = 100 microinches)



Photomicrograph
Magnification: Vert. × 100; Horiz. × 100

Fig. 9—Cylindrical surface Superfinished with 39500 L13CCrystolon vitrified sticks. Operation for 2½ minutes at 59 p. s. i. using a 10:1 mixture of Sunoco spirits and International compound as lubricant.

Profilometer	1.6 mu in., rms.
h_{max} Brush analyzer	16 mu in., actual
h_{max} taper section	15 mu in., actual

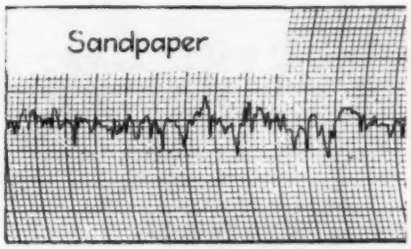
Removed 0.0001 in. from ground prior surface of roughness 5 mu in., rms.

and will appear as if they were undercut.

In Fig. 8 we recognize a spalled surface in which there are isolated depressions rather than continuous scratches. A normal section (the analyzer curve) cannot differentiate between spalled and scratched surfaces. However, in taper sections, even with inclined scratches as in Fig. 7, or with depressions as in Fig. 8, the maximum depth of scratches or depressions can be determined by measuring in a direction perpendicular to the mean contour direction (see also Fig. 2).

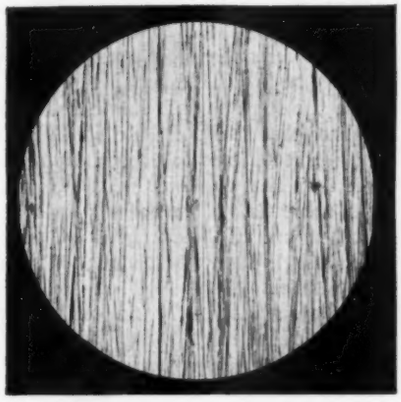
A comparison of Fig. 4 with Fig. 5 and with Fig. 7 reveals a source of error in tracer-point methods of measuring roughness, as indicated by measurements of the peak-to-valley distance, h_{max}, which are taken from these figures and are given in the last two columns of Table I. The taper sections show that h_{max} is practically the same for the two ground surfaces, Figs. 4 and 5, but both the profilometer and the analyzer show considerable differences in the surface roughness. This is undoubtedly caused by the failure of the 500 micro-inch radius tracer points of the Abbott Profilometer and the Brush Analyzer to go to the bottom of the fine scratches on the surface that was ground with the finer grit wheel.

Scratch depths less than about ten micro-inches cannot be measured with certainty by the technique described herein. The use of smaller taper angles will, in theory, magnify scratch depths indefinitely without loss in resolution but in practice the sectioning process itself must be expected to introduce errors. The limit of optical resolution, about ten micro-inches, is the limiting factor in resolving scratch width, but



Brush surface analyzer curve. Magnification: Vert. × 25,000; Horiz. × 100

Taper section.* Magnification: Vert. × 2,500; Horiz. × 100

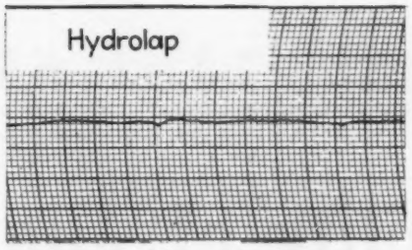


Photomicrograph
Magnification: Vert. × 100; Horiz. × 100

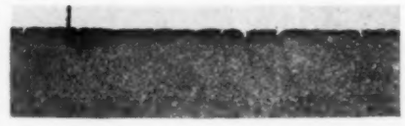
Fig. 10—Cylindrical surface sandpapered with No. 320 Alundum paper. Operation for one minute using a 10:1 mixture of Sunoco Spirits and International Compound as lubricant.

Profilometer ..... 5 mu in., rms.
h_{max} Brush analyzer..... 24 mu in., actual
h_{max} taper section..... 30 mu in., actual

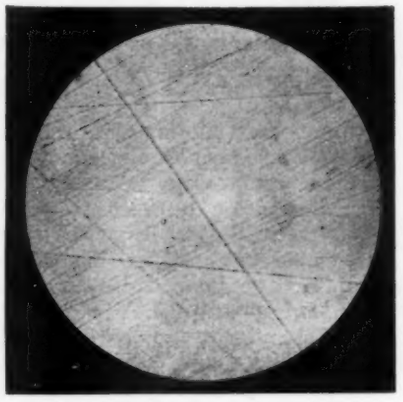
Removed 0.0002 in. from ground prior surface of roughness 20 mu. in., rms.



Brush surface analyzer curve. Magnification: Vert. × 25,000; Horiz. × 100



Taper section. Magnification: Vert. × 2,500; Horiz. × 100
(Black vertical line = 100 microinches)

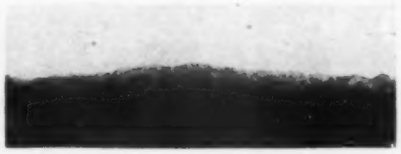


Photomicrograph
Magnification: Vert. × 100; Horiz. × 100

Fig. 11—Flat surface "Hyprolapped" with levigated alumina 17T resinoid bonded wheels. Operation for two minutes with an initial pressure of 53 p. s. i. and Lux flakes in water as a lubricant. Some of the scratches appear to have been left from a previous operation.

Profilometer ..... 1.1 mu in., rms.
h_{max} Brush analyzer..... 2 mu in., actual
h_{max} taper section..... 20 mu in., actual

Removed 0.0000 in. from "Hyprolapped" prior surface of 2.5 mu in., rms.



Taper section. Magnification: Vert. × 2,500; Horiz. × 100

Fig. 12—Flat surface electrolytically polished. Since this SAE 6150 steel is not so readily polished electrolytically as many other metals, this surface cannot be considered typical. This section, however, does illustrate the smoothing of fine-scale roughness.

Profilometer ..... 4 mu in., rms.
Brush analyzer curve..... Not taken
h_{max} taper section..... 15 mu in., actual
h_{max} taper section (including waves) about 50 mu in., actual

Sample electrolytically polished from a prior surface of 4 mu in., rms. roughness, prepared by hand stroking on 3/0 metallographic polishing paper. The sizing of the emery abrasive in this Behr-Manning 3/0 Emery polishing paper is somewhat finer than No. 500 Alundum.

Taper section. Magnification: Vert. × 2,500; Horiz. × 100

Fig. 13—Flat surface metallographically polished on broadcloth with rouge. This section constitutes one test of the taper sectioning method. Since this section comes out smooth within the 10 microinch resolving power of the method, we have here a proof that the roughnesses shown in the preceding figures are real roughnesses and not introduced in the taper sectioning procedures. The two scratches deliberately left on the polished section show that accidental scratches on the taper section do not seriously affect the results.

Profilometer ..... Not taken, but probably around 1 mu in., rms.
Brush analyzer.... Not taken
h_{max} taper section Less than 10 mu in.

since the scratch width is usually several times the depth, the final limitation of the method is probably due to roughnesses and distortions introduced in the sectioning process.

It is a pleasure to acknowledge the help and co-operation of Drs. L. H. Milligan and R. McG. Robertson, of Norton Company, and the skillful assistance of R. S. Peoples of the Battelle staff who prepared the taper sections.

*The dark line along the surface contour indicates a slight change in slope and a possible source of error in magnification due to an unsatisfactory nickel plate.

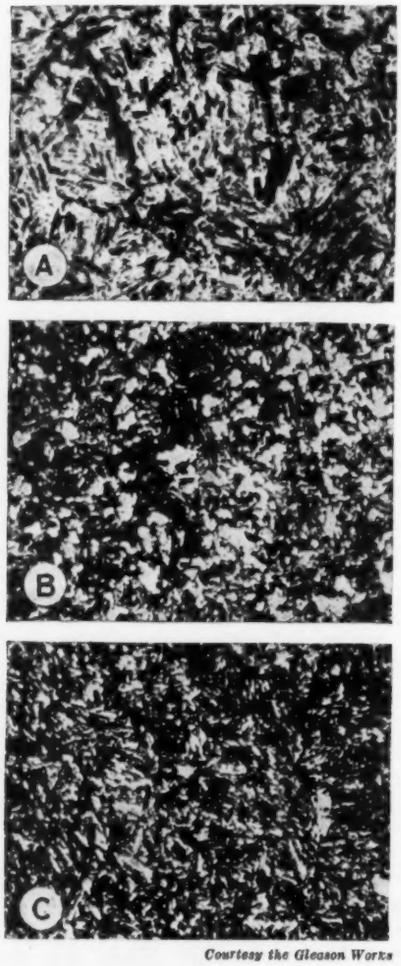
Table I—Comparison of Roughness Measurements Made by the Abbott Profilometer, the Brush Analyzer and Taper Sections

Figure No.	*Finishing Process*	*Abrasive Size*	*Profilometer Micro-inches, rms*	*h_{max}, micro-inches**	
				Analyzer Curve	*Taper Section*
4	Ground	46 Mesh	12	72	85
5	Ground	80 Mesh	6	50	85
7	Lapped	#600 Alundum	3	30	50

*The largest spread in peak-to-valley distance was taken from the analyzer curve for the value of h_{max}. On the taper sections, isolated deep scratches were neglected; the h_{max} value being obtained by the technique previously described.

Adaptability of Alloy Steels

BY J. G. MAGRATH, APPLIED ENGINEERING DEPARTMENT, AIR REDUCTION COMPANY



Courtesy the Gleason Works

Fig. 4—These microphotographs *at 500× were taken of an SAE 4640 steel gear tooth hardened by the Gleason Works. A shows the microstructure of the area of greatest hardness; B the microstructure of the transition area; and C, the microstructure of the core which is entirely unaffected by the flame hardening. The steel has been self quenched (still air), water being employed only to cool the body of the gear and the teeth adjacent to the gear tooth being hardened.*

Getting best results in flame hardening alloy steels requires an understanding of what each alloying element contributes to the conditions of this process

IF THE VARIOUS alloying elements other than carbon, encountered in flame hardening low-alloy steels were to be arranged according to the relative intensity of their effects on hardenability, in the proportions normally found, we would have the following sequence:

1. Manganese
2. Chromium
3. Molybdenum
4. Vanadium
5. Nickel
6. Silicon

Certain of the alloying elements, such as chromium and molybdenum, affect the hardness obtainable[4]

(*a*) by solid solution hardness; i.e. increase in the hardness or strength of the ferrite by solution of the alloying element in the ferrite grains.

(*b*) by changing the nature of the carbide constituent.

For practical purposes the increase of the maximum hardness obtainable with alloy additions is secondary to their effect on hardenability.

While the difference in hardness obtained with alloy steels and with plain carbon steels of similar carbon content is generally slight, where higher core strength and greater shock resistance are needed, flame hardenable alloy steels are recommended. It is claimed that the alloy steels also have an additional advantage of resisting tempering to a greater extent than plain carbon steels. Such tempering occurs to a minor degree (in steels having had a preliminary heat-treatment) in the zone immediately below that which has been hardened. This may be of engineering importance where high fatigue stresses are involved.[2]

Nickel-chromium SAE 3100, molybdenum SAE 4100 and chrome-vanadium 6100 steels, which have been preheated to give exceptional core properties, are flame hardened to produce the requisite surface hardness in excess of the core hardness. The expected intermediate zone of low hardness is present in most cases but to an almost negligible extent. In passing from the high surface hardness to the normal core hardness, the zone which has been tempered to a higher temperature than that to which the entire part was subjected in preheating, has not been appreciably softened by flame hardening. The time element and the sluggishness of reaction of the alloy steels are undoubtedly responsible for this beneficial effect.

Very little difference is to be observed in the microstructure of flame-hardened alloy steels as compared with the structure of plain carbon steels of equivalent carbon content.

A number of successfully flame hardened SAE and special low and high-alloy steels are shown in Table V, and the effect of flame-hardening gear teeth of SAE 4640 steel is shown in Fig. 4.

Alloys are generally recognized as contributing the following properties to steels in their "as rolled" state:

CHROMIUM tends to increase hardenability and provide increased tensile and creep strength at high temperature. It imparts enhanced oxidation, corrosion and scaling resisting qualities, and abrasion resistance in high-carbon compositions. In properties up to about 1.00 percent, it is more effective than manganese[12] in contributing toward hardenability. It is frequently recommended that steels with greater than 1.00 percent chromium be carefully preheated in order to avert fissures. 13.00 percent chrome steels with carbon as low as 0.12 percent have been successfully flame hardened. Combined chrome and nickel provide high elastic limit (resistance to distortion) and freedom from brittleness. These properties are also contributed by combined chrome and vanadium which, in addi-

Table V—ALLOY STEELS

Steel Classification	S.A.E. No.	Analysis C	Mn	Si	Cr	Ni	Mo	V	Brinell Hardness* Before Flame Hardening	After Compressed Air Quench	After Water Quench
		0.25	0.34		0.48	3.55			269		477
		0.25	0.46		0.61	3.70	0.42		363		555
		0.35	0.37		0.56	3.55			255		601
		0.60	0.70		0.62	.16			255		601
Nickel	2330	0.30	0.68			3.48					600
"	2340	0.36	0.70		0.20	3.34					585
Nickel-Chromium	3140	0.40	0.80		0.60	1.25					540
"	3230	0.29	0.56		1.16	1.52					610
"	3435	0.34	0.58	0.18	0.79	3.06			255		490
" 1%		0.41	0.68	0.25	1.44	1.72			258		512
" 4%		0.33	0.54	0.17	1.29	3.95			302		460
Molybdenum	4140	0.42	0.62		0.92		0.27				600
"	4150	0.50	0.75		0.95		0.20				660
"	4640	0.40	0.75			1.65	0.25			415	
Carbon-Molybdenum		0.68	0.75	0.22			0.34				712
Chromium	5140	0.42	0.71		1.05						615
Chromium-Vanadium	6140	0.40	0.75		0.95			.17		500	
"		0.43	0.73	0.24	1.01	0.16		.14	257		600
Corrosion and Heat Resisting	51210	0.12	0.60		13.00		(Forging Stock)			444	
	51210	0.12	0.60		13.00		(Rolled Stock)				444
Manganese		0.31	2.86						300	532	
"		0.29	2.90						289	528	580
Nickel-Chrome-Moly		0.32	0.56		0.72	2.56	0.42				555
Manganese-Molybdenum		0.40	2.50				0.18			600	
"		0.45	1.10				0.25				600
Chrome-Manganese-Moly		0.50	1.15		0.50		0.15				625
Carbon-Vanadium		0.90						0.25			725
Special		0.36	0.65		0.96	3.01	0.30	0.02			506
"		1.25	0.20		0.50						614**

* Hardnesses as shown are not indicative of maximum hardness obtainable but are representative of flame-hardening results using varying quenching rates to meet specifications.

In general the maximum hardness obtainable from a steel is dependent on the carbon content and is unaffected by the presence of other alloys.[4] The effect of these other alloys manifests itself largely in the relative ease with which steels can be hardened; this characteristic of a steel is generally termed its " hardenability ".

* * Mild water quench.

tion, give a steel which has fewer imperfections, and which rolls, forges and machines better. Chromium raises the critical temperature.

MANGANESE inexpensively provides a moderate contribution to hardenability; in ordinary amounts this result is greater than for nickel, less than for chromium.[12] Toughness and machinability is improved; strength in ferrite is increased. It lowers the critical temperature. Manganese steels having an Mn content of 2.90 percent with 0.29 percent C have been successfully flame hardened to 580 Brinell with a carefully controlled water quench and to 528 Brinell when quenched with compressed air.

MOLYBDENUM contributes greatly to hardenability; in proportions up to about 1.00 percent it is more effective than chromium, and raises high-temperature strength and creep resistance.[12] It refines the grain structure, inhibiting growth at temperatures well above the critical. It intensifies the hardening effect of other present alloying elements and contributes to deep-hardening depth. Close temperature control is not so critical. Molybdenum raises the critical temperature. SAE 4140 and 4150 molybdenum steels have been successfully flame hardened to 600 and 660 Brinell respectively.

NICKEL'S contribution to hardenability is mild. It imparts strength and non-corrosive properties. It is employed for producing steels of moderate or high hardenability (depending upon other elements) having relatively low required heating temperature and high toughness as tempered, especially at low testing temperature, and promoting toughness in pearlitic-ferritic steels.[12] Nickel lowers the critical temperature.

PHOSPHOROUS, considering the small content in which it is found in steel, contributes measurably to hardenability. It is a strengthener in low carbon steel to which it confers corrosion resistance, and improves machinability in high-sulphur, free-machining steels.[12]

SILICON moderately increases hardenability in steels carrying other non-graphitizing elements. It promotes graphitization and improves oxidation resistance. It increases the strength in quench and tempered steels and pearlitic steels.[12]

VANADIUM'S contribution to hardenability is marked when dissolved even in small amount.[12] It elevates the coarsening temperature of austenite and therefore provides the advantage of fine grain structure.

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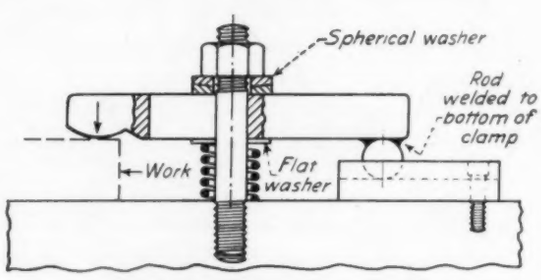
4. Notes on Flame Hardening, by G. V. Slottman; July, 1940
12. Functions of the Alloying Elements in Steel, by Edgar C. Bain, U. S. Steel Corporation, 1939

The next installment of this series will be found in an early number.

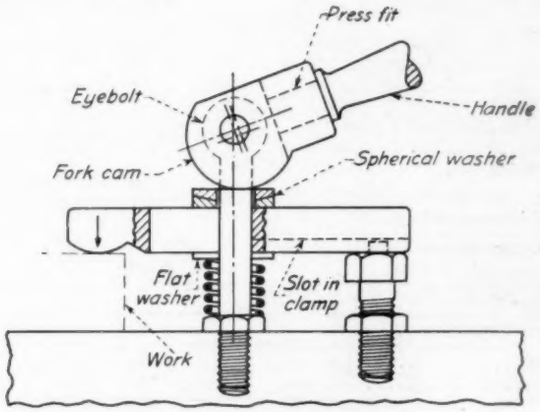
Work Clamping Devices—I

BY JOHN G. JERGENS, CLEVELAND PNEUMATIC TOOL COMPANY

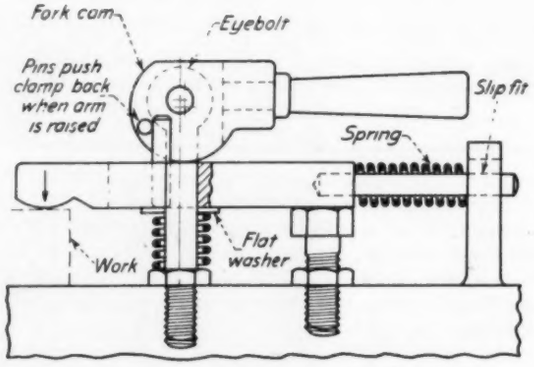
THREE MAJOR considerations govern the selection of a clamping device for a jig or fixture. The device, first of all, must be strong enough to hold the work. Then it must be rapid in operation so as not to delay the operator in placing and removing the work. Last, but not least, it should be foolproof—a clamp that does not work properly every time is a constant source of annoyance to the operator and a factor in keeping shop costs high. The devices shown in this group all are designed to hold work down against a jig plate or machine table and each can be varied in design to suit job conditions. In all but two of these arrangements the clamp bar is supported above the work by a spring until the device is operated to close and tighten the clamp.



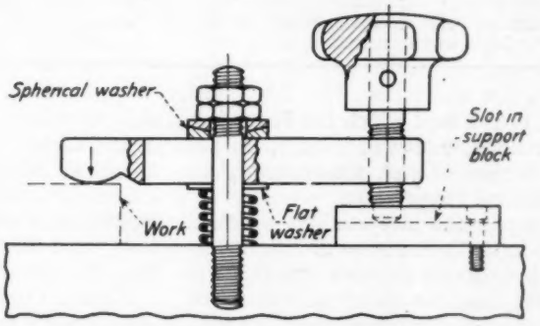
Wrench-operated clamp



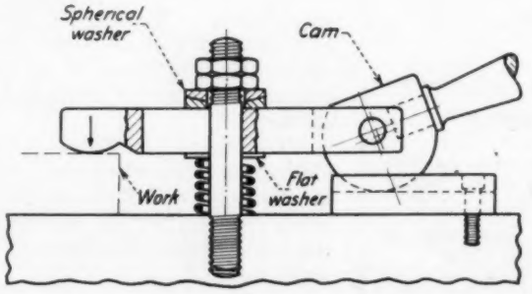
Simple cam-operated clamp



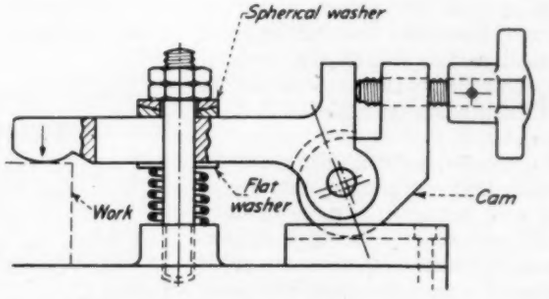
Cam-operated clamp with bar return



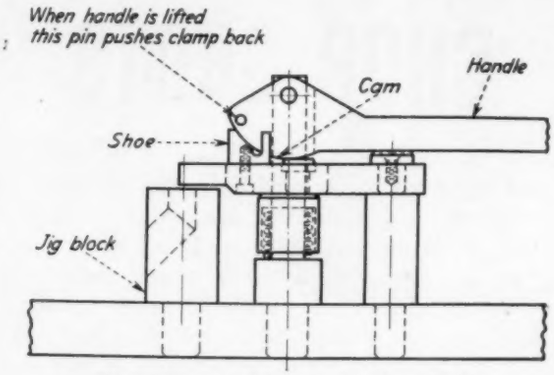
Screw-operated clamp with hand knob



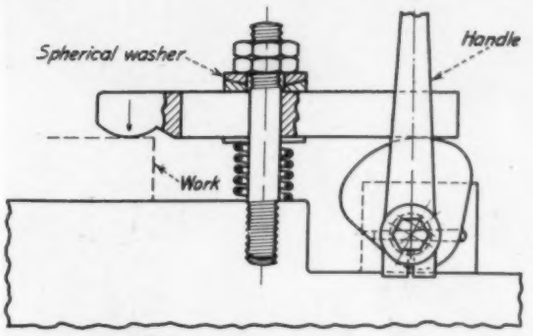
Another cam-operated clamp



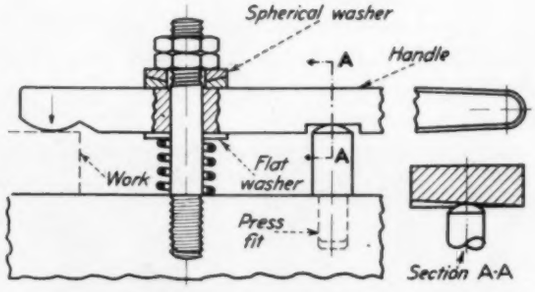
Cam-operated clamp with screw



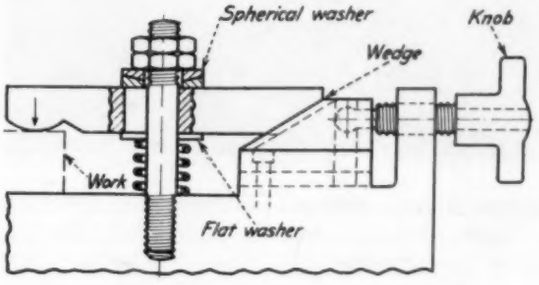
Cam-operated clamp with bar return



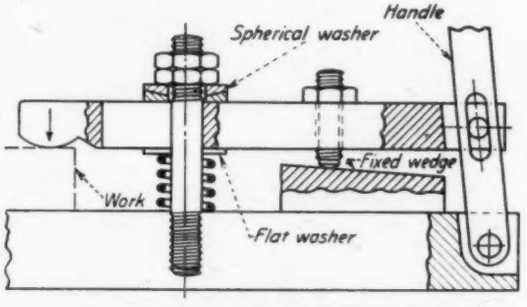
Modified cam-operated clamp



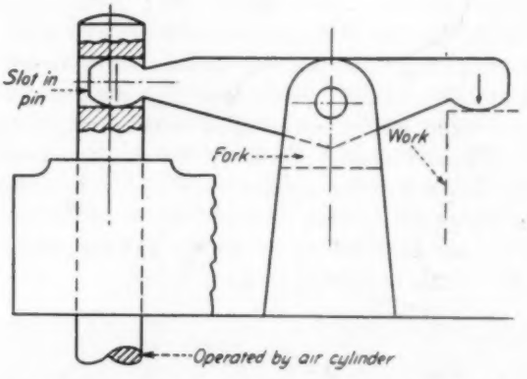
Wedge-type swivel clamp



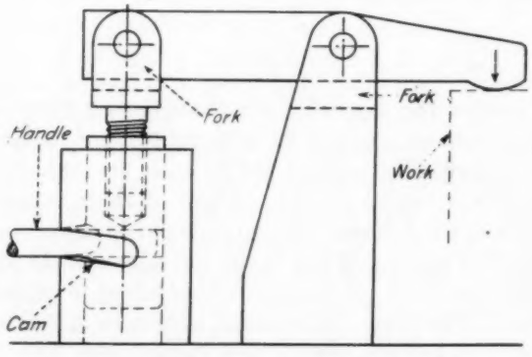
Wedge-operated clamp with screw



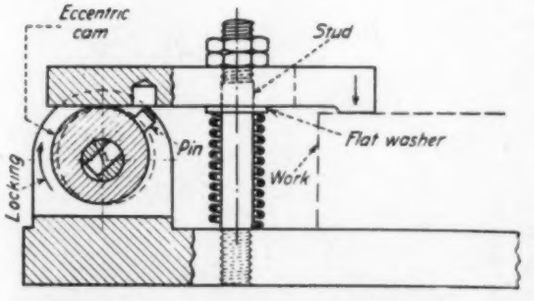
Wedge-type clamp with hand lever



Clamp operated by double-acting cylinder



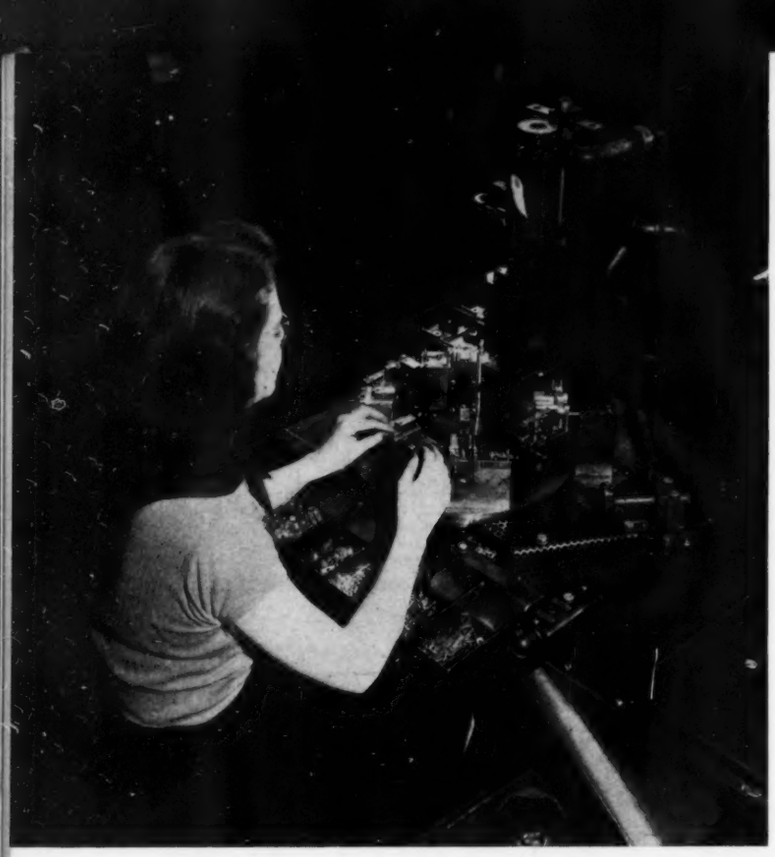
Quick-acting clamp with barrel cam



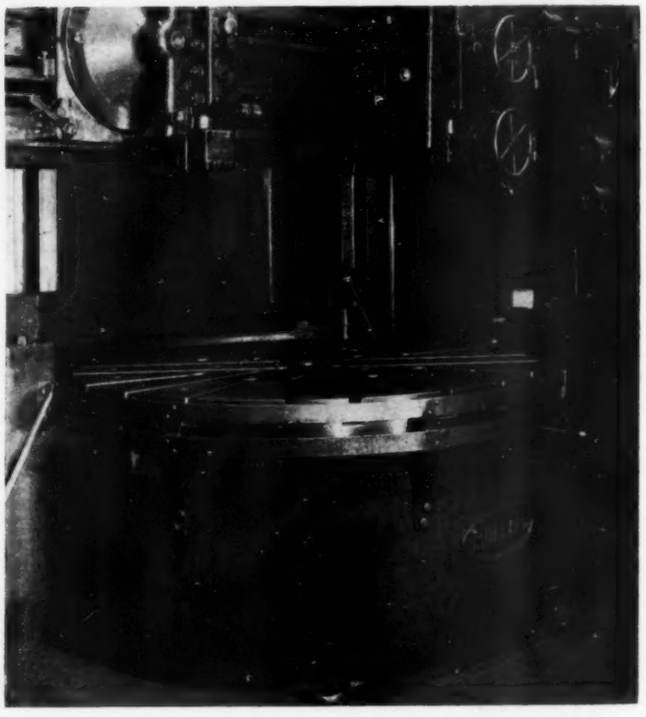
Quick-acting cam clamp with bar return

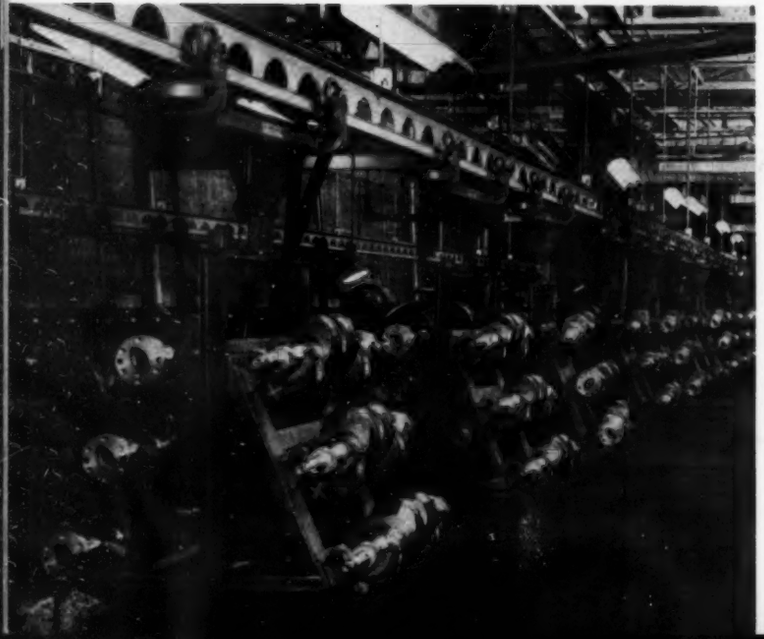
SHOP SHOTS

Practical guards for vertical boring mill tables can be made of 2 x $\frac{3}{8}$ in. or 2 x $\frac{1}{4}$ in. scrap iron, depending on the size of the mill. They are bolted to the base of the machine, being supported by suitable brackets, and they are spaced to allow a $4\frac{1}{2}$-in. clearance between the table and the guard ring. The top of the guard may be at the same level as the top of the table, or an inch or two below it. One section of the top strut, forming the guard, can be made removable in order to facilitate cleaning the T-slots in the table. For larger mills, a metal stool is provided for the operator to stand on when checking operations on work which is too high to be reached from floor level. D. P. Brown, plant engineer, Canadian Westinghouse Company.

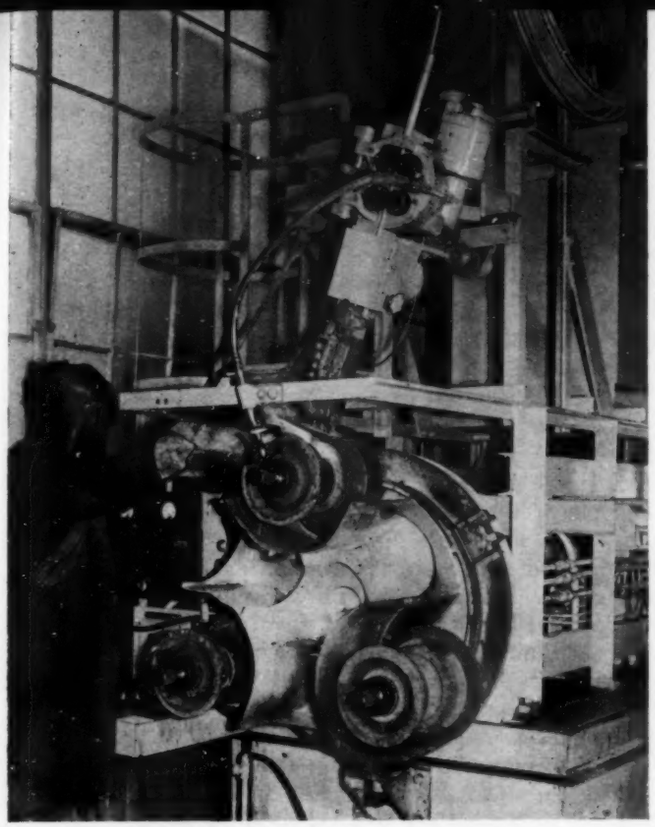


The automatically-indexed platform of this assembly fixture carries a number of similar stations. At each station there is a forming die and riveting fixture for which mating tools are mounted on the air-actuated ram at the rear. During each work cycle a shunt bar is formed and a contact finger assembly is riveted in the tools under the ram. In the meantime, the operator takes a formed shunt from the die in front of her and assembles it with a contact finger, spring, washer and rivet on the riveting, or left-hand part of the station. At the same time she places an unformed shunt on the just emptied forming die at the right in the same station. To adapt this merry-go-round assembly fixture for other small assemblies, it is necessary only to change the tools on each station and on the ram. Fred Heer and Carl Bolling, Switchgear Division, Westinghouse Electric & Manufacturing Company.

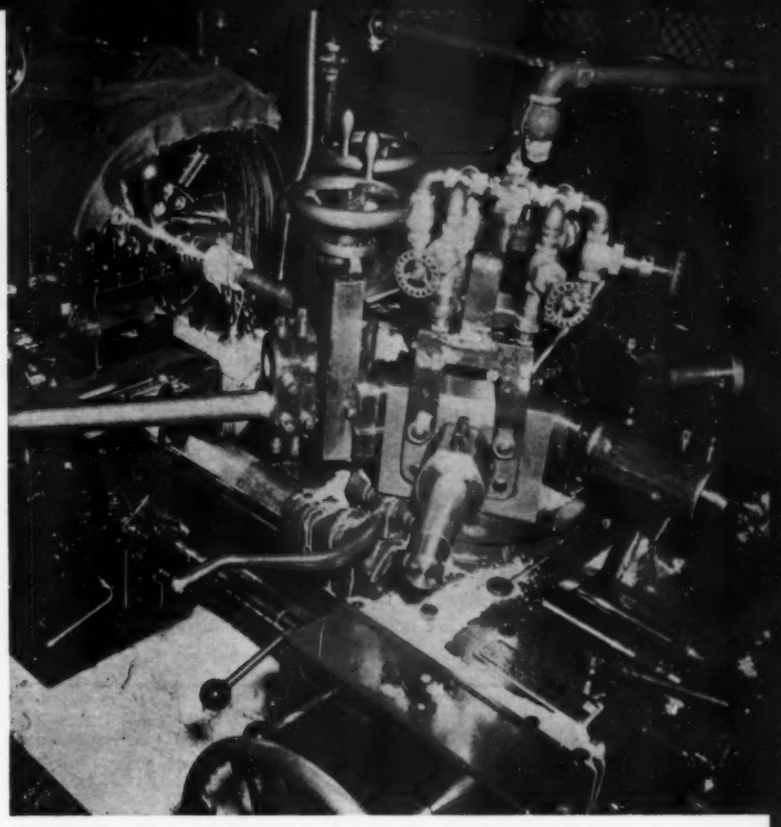




Cradles for carrying crankshaft on a 500-ft. endless overhead conveyor are arranged to carry six sizes of crankshaft. The supports for the shaft are made of bent steel bars welded to short sections of angle iron which hook to the A-frame. The supports can be moved quickly to other opening in the frame for other sizes of shafts. The bent rod is covered with rubber tubing to protect the shaft. The frame can be turned in relation to the trolley, and is locked into position by a spring-loaded latch. This can be released by a pull chain which is threaded over two pulleys and brought down the side of the frame to a convenient height. International Harvester Company.

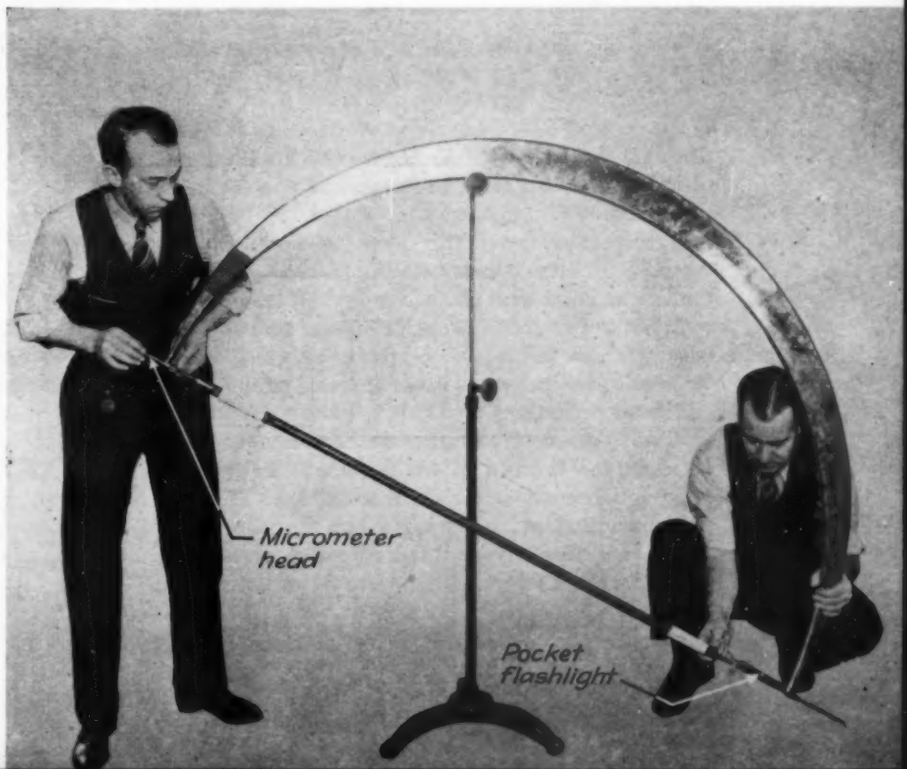


Tractor track rollers formerly made of two forged wheels shrunk on a cast iron hub now are made by welding two forgings in the special machine shown. Forgings are received with the hub edges bevelled ready for welding. They are loaded on a spindle as shown at the lower right. The bevelled joint is preheated at the lower left station, and arc welded at the upper station. Fixture on which spindles are mounted indexes automatically, while the spindles rotate the forgings at a proper speed under the welding arc. After welding, the track roller moves down a gravity conveyor to a water pressure test. If no leaks show up in the weld, the parts travel down the conveyor to an annealing furnace. Later the center bore is broached and the flanges are turned and faced. The rolling surfaces then are hardened by induction. Caterpillar Tractor Company.



Coolant piping—A 15-in. deep, 2-in. diameter hole had to be bored and reamed in the steel bar shown in the chuck of this turret lathe. Standard hose could not force coolant to the bottom of this hole, so the piping arrangement shown was made up. The spider of iron pipe was mounted on the turret with a welded steel strap frame, and the tee which forms the center of the spider is connected to the flexible coolant piping of the lathe. Six lead pipes, each with an independent control valve, connects the spider to the individual boring bars and cutting tools. A rubber hose connects the end of the pipe with a nipple on the end of the boring bar. A $\frac{1}{4}$-in. hole is drilled to the end of the bar where a $\frac{3}{16}$-in. opening just behind the cutting tool directs the coolant over the tool and forces the chips away. Boyar-Shultz Corporation.

When making measurements with large micrometers, the mass of the parts handled is so great that there is a tendency to adjust the micrometer too tight, and thus get a reading that is several thousandths smaller than the true reading. This error can be avoided if an ordinary fountain-pen type flashlight is attached to the anvil of the micrometer, the anvil being insulated from the frame. Then the flashlight is connected with one side of the circuit to the insulated anvil, and one side to the micrometer frame. When taking a measurement, the anvil of the micrometer is held against the part and the micrometer screw is run down. When it touches the part being measured, the light flashes on. A sensitivity of half a thousandth can be achieved. The illustration shows how the flashlight is used; it does not show the best way to set a micrometer. R. L. Molt, Generator Division, Westinghouse Electric & Manufacturing Company.

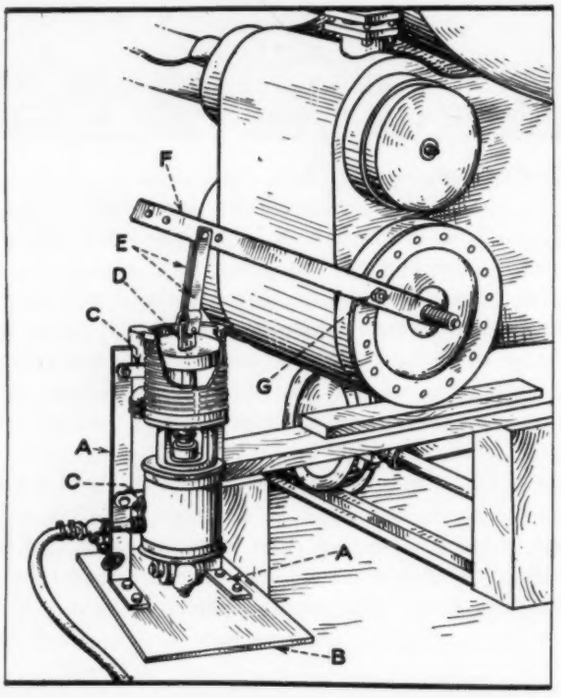


IDEAS FROM PRACTICAL MEN

Cylinder Heads Ground with Inverted Air Pump

BY ARTHUR HAVENS

One of the most tiresome and back-breaking jobs in the railroad back shop or enginehouse is the grinding of back and front cylinder heads. Several cam-shaped cylinder-head grinders driven by air motors have been made but have not proved entirely satisfactory, because they are too slow. This is not true of the illustrated grinder. It is fast, easy to set up and positive in its operation.



A 9½-in. air pump inverted as shown and operated by compressed air, can be used successfully for grinding cylinder heads

Perhaps the reason this idea has not been universally accepted is because most railroad men labor under the impression that a standard 9½-in. air pump will not run successfully upside down. It is apparent that this is a fallacy for the pump we use has been in service several years in its inverted position and still runs perfectly.

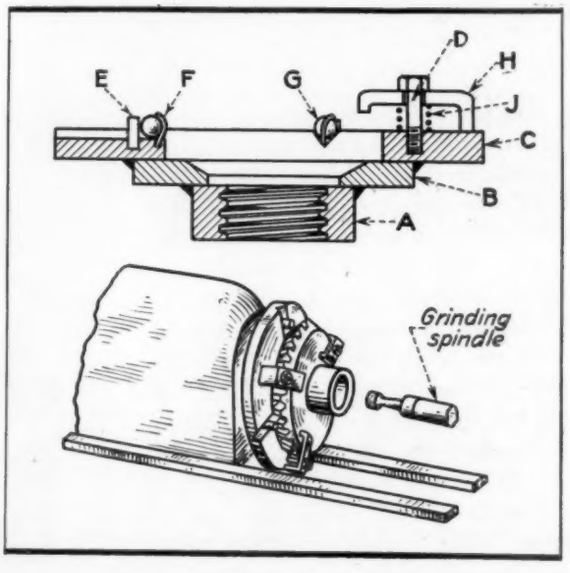
Two ⅝-in. steel bars *A* were bent into L-shaped brackets and fastened to a ½-in. plate *B* 4 ft. square. The upright section of these brackets were drilled to accommodate the bracket lugs *C* on the pump. The pump was then inverted and bolted in place. The air-end cylinder head, valves and valve cages were removed as were the air-end piston-head nut. A block of steel *D* was bored and threaded to replace the piston nut. This block was drilled to take a ¾-in. hinge pin. Two pieces of ½x2-in. strap iron *E* were formed with an offset to fit over the hinge block and the other end to fit a piece of ¾x3 in. iron which is driving arm *F*. This arm is drilled to slip over the stud in the front head or to fasten to the packing gland studs in the back head. A series of $\frac{1}{16}$ in. holes are drilled in the other end of the driving arm so that the pump can be moved to a convenient spot near the locomotive. A heavy coil spring is used to hold the head in place and let it move freely during the grinding operation. When grinding a front head a short stub of a 1-in. bolt *G* is placed in the driving arm and in a stud hole of the head.

This makes a very efficient device and the worst cylinder-head seat can be ground steam tight in a minimum of time.

A Chuck for Bevel Pinions

BY THOMAS O. FORD

We had the job of making a limited number of beveled pinions with an integral hub. In order to secure the proper alignment it was necessary to grind the bore after hardening. To do this, and at the same time keep the pitch line of the pinion running true,



This fixture was designed to chuck hardened beveled pinions on an internal grinder so that the hub bore would be ground concentric with the face of the pinion

we decided to chuck the pinion by the tooth spaces for the internal grinding operation.

Not having a special chuck for this purpose and not wishing to purchase one for the limited quantity involved, we made the chuck as illustrated. Three pieces of steel were machined in rings and welded together. The smaller ring *A* which forms the hub of the chuck, was bored and threaded to fit the spindle of our internal grinding machine. A flange *B* was welded to this hub, and in turn an outer ring *C* was welded to flange *B*. This last piece was the work-holding unit. Three holes for the clamping studs *D* were drilled and tapped in this ring.

Since the threads in hub *A* had already been cut the problem was to fix the work-positioning points so that they would hold the pinion concentric with the spindle and at right angles to the axis of rotation. In order to do this the chuck was set up in the grinding machine in which it was to be used, and spots were ground on the face of ring *C*. Then the chuck was set up in a dividing head on a milling machine and aligned by means of a dial indicator so that these spots were exactly parallel to the milling machine spindle. With the chuck in this position three V-grooves were cut in the face of part *C* 120 deg. apart. In each of these grooves a hole was drilled and reamed for the heavy pin *E*. In addition, the smaller holes were drilled for the heavy wires *F*.

Clamping studs *D* and pins *E* were then fitted in place and the chuck again set up in the grinding machine. In this position a light cut was taken off the pins to make sure that their inner surfaces were concentric to the spindle. The wires *F* were then added, and steel ball *G* were placed in each of the three positions between the pins *E* and the wires *F*. Then the wires were bent over to hold the balls in place. Clamps *H* and springs *J* were then assembled to make the chuck complete.

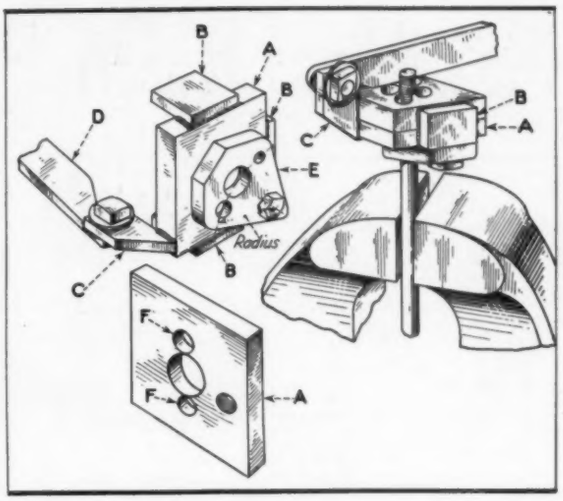
This procedure gave a chuck in which the steel balls were positioned both radially and axially, according to location determined by the internal grinder itself. The wires fitted between the tooth spaces of the pinion, leaving the only point of contact the steel balls themselves and the clamps which held the pinion in place. A proof of this device was that the pinion ran true on the bore after it had been ground.

Guide For Block Die Insures Straight Threads

BY W. E. ABBOTT

It is difficult to start a block die straight when cutting a thread on either long or short stock. It was to insure cutting a straight thread with such a die that I devised the guide block shown in the drawing.

It consists of base *A* on three sides of which are welded retaining pieces *B*. On the fourth side piece *C*, drilled and tapped $\frac{3}{8}$ in., is welded near one corner and serves as a hinge plate for eccentric clamp handle *D*. The handle is hinged with a $\frac{3}{8}$x1$\frac{1}{2}$-in. bolt, which screws into plate *C* and held by a nut.



This block-die guide holds the die square on the stock and insures positive starting and cutting of a straight thread

On the underside of the guide block, part *E* is held with a $\frac{3}{8}$x1-in. capscrew. Part *E* is a guide for the rod to be threaded, and is drilled with three holes, $\frac{3}{8}$, $\frac{1}{4}$ and $\frac{9}{16}$ in. diameter, respectively, all on the same radius from the center of the capscrew, so that it can be swiveled to bring the hole corresponding to the stock size beneath the hole in the center of base *A*. A $\frac{3}{8}$-in. hole *F* is drilled on each side of the center hole in base *A* for chips to fall through the guide when cutting the threads.

When in use, the stock is clamped in a vise, the proper size hole in swivel plate *E* is swung into position, and the block die inserted on top of plate *A* where it is held by side retainers *B* and eccentric clamp *D*. The latter is welded near one corner of the guide so it will not interfere with the stock as it protrudes through die while cutting the thread.

Methods for Forming Eye On Close-Wound Springs

BY JOHN F. CAVANAGH

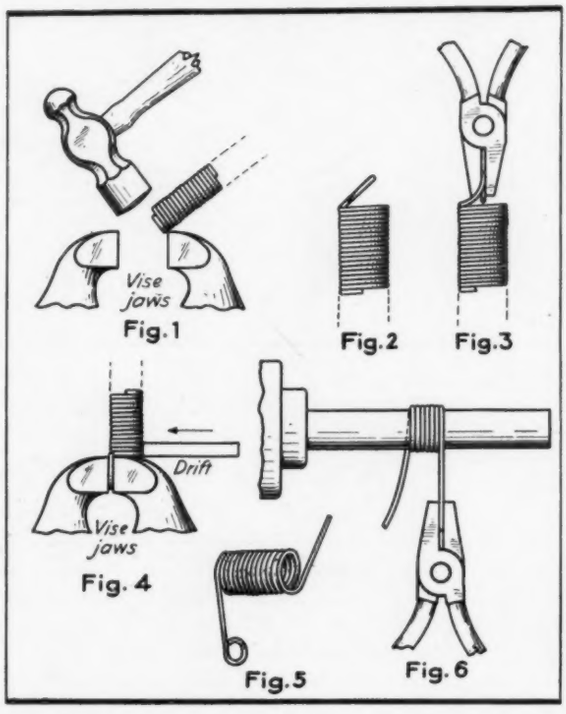
Forming eyes on the ends of close-wound springs is difficult unless one knows the kink which makes it easy. Fig. 1 shows how the last coil is opened in the first step in forming the eye. Hold the spring at an angle of about 45 deg. as shown, with about one-half the last coil over the edge of the jaw.

With springs of wire sufficiently light to be bent with a plier, open the last coil with a hammer blow to bring it to the position shown in Fig. 2. Then with a plier grasp the end of the coil and twist to the central position shown in Fig. 3.

A spring of heavy wire should be opened until the last coil takes the position shown in Fig. 4. It can then be gripped in the vise and with a piece of flat stock as a drift and a hammer, the body of the spring may be forced central over the eye.

Hub or torsion springs of the form shown in Fig.

5 sometimes require very definite positions for the ends or arms and it is very difficult to wind to the required angular position. The trick in this case is to wind the spring a few turns longer than required.



A vise, pliers and hammer are usually the only tools needed to form eyes on the ends of close-wound springs. The successive steps forming the eyes are shown

With the spring on the arbor and both ends free, grasp one end with a plier and pull. This action will unwind the end turns one at a time and permit positioning of the ends to exact requirements as shown in Fig. 6.

Punching Aluminum Disks 0.001-in. Thick

BY F. C. HUDSON

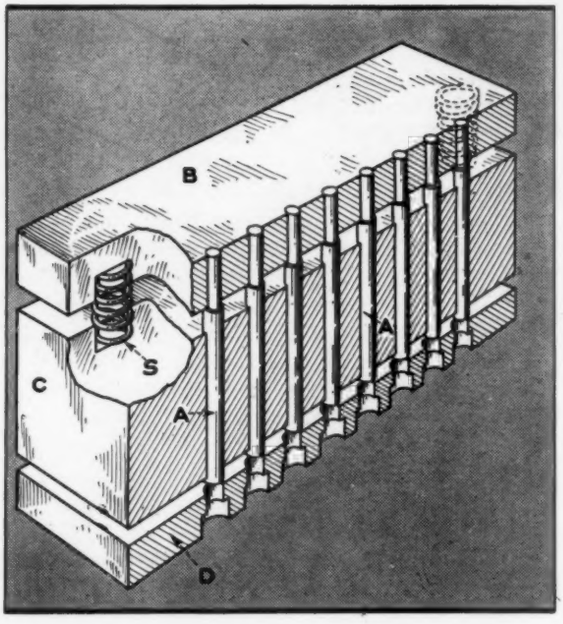
Punching small disks from sheet aluminum seems like an easy job. But when the aluminum is only 0.001 in. thick and the disk only $\frac{3}{16}$ in. diameter, it becomes a real problem. Millions of these disks are now being made for the army for a special purpose.

Making the punches and dies for these disks is a real toolmakers job. There are eight punches in a row with just enough space between them so the whole eight are spaced across a 2-in. ribbon of alumium strip. Clearance between punch and die cannot be over 0.001 in. because more than this tends to cup the disk as it goes through the die. And lining up eight punches and the corresponding holes in the die plate to maintain equal clearance and to prevent interference, is a real job. The drawing shown gives an idea of the way in which the problem was mastered.

The punches were made from $\frac{3}{16}$-in. drill rods *A* with the ends reduced to go in the block *B*. The block *C* guides the eight punches and insures alignment with the dies in the block *D*. The springs *S* return the punches after they have been forced down by the ram of the press, a round bar in the ram keeping contact with rods *A*. The strip stock is fed through the opening between the guide block and the dies by means of rollers actuated by the ram as it descends at each stroke.

The punchings are forced through the die and into the enlarged cavity from which they fall into a box. Being so light it was feared that they might not clear the die; therefore, a hole was drilled in each punch for a low-pressure air jet to force them off the end of the punch. It was found that even a low-pressure air cupped the disks to an appreciable extent; therefore, this was abandoned. The enlarged cavity in the die for clearance seems to work all right.

Lining up eight holes in three separate pieces *B, C* and *D* is a nice job even when they are all done at once. To insure a good sliding fit, which would guide the punches into the dies with so little clearance, reamers were made from the same drill rod as was used for the punches. The holes had to be carefully drilled and bored to insure them being parallel in both directions. Then they were reamed with the reamers made from the drill rod itself, and an excellent job was secured in this way.

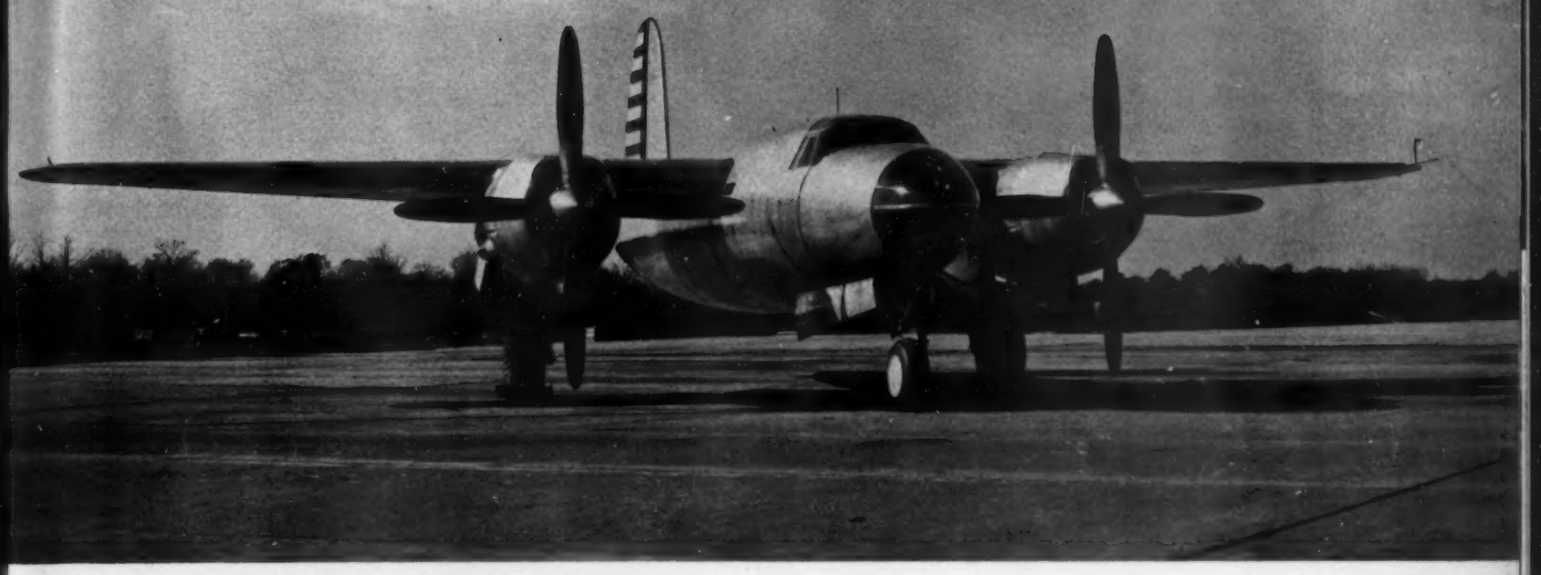


This arrangement of punches, die block and die is used for punching aluminum disks 0.001 in. thick and 3/16 in. diameter from strip stock 2 in. wide

Some idea of the smallness and lightness of these disks can be had from the estimated weight of $2\frac{1}{2}$ lb. per million disks.

Armament

SECTION OF AMERICAN MACHINIST



BUILDING A BOMBER

There's some argument as to where land and sea power end and where air power begins. But there's no argument as to the need of more bombers—plenty of them and soon

IN THE INVASION of Crete the strategic value of air power was again emphasized. For the first time in history an island was taken with little dependence on sea power—in fact, in the face of vastly superior sea power. Whatever conclusions our military experts may draw from this, none will deny the urgent need for war planes, particularly bombers, by both Great Britain and the United States.

Glenn L. Martin built the first bomber; today his plant on the Chesapeake Bay, at Middle River, Md., is turning out bombers for England, for the Army and for the Navy.

Let us consider one of the many types of these ships of the air—the Martin B26, one of the Army's most advanced medium bombers. It is faster than most pursuit planes fighting in Europe today, having a speed of more than 300 miles an hour with full military load. It has a bomb carrying capacity over twice as great as any previous plane its size.

The B26 has a power-driven turret atop the fuselage, another in the tail of the ship and still another machine gun position ahead of the pilot in the nose. It is driven by two Pratt & Whitney 1850-hp. engines. It embodies the latest features for modern combat: self-sealing fuel tanks and protective armor.

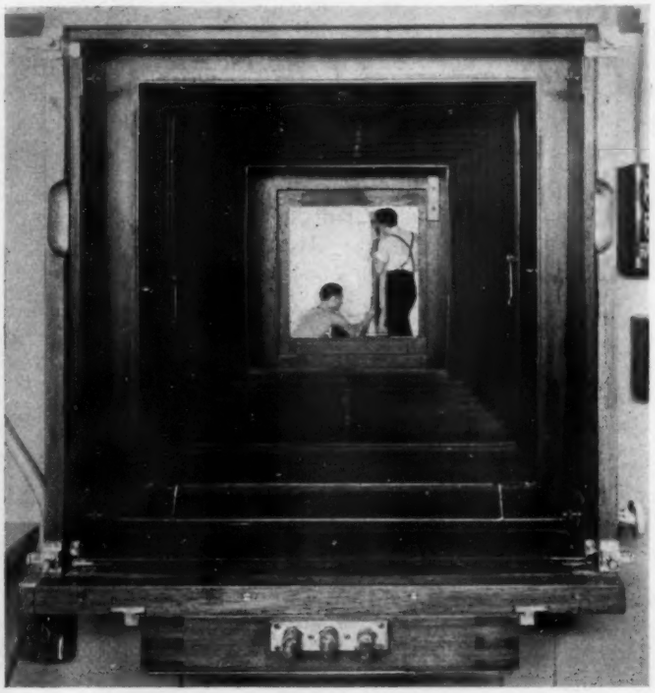
Glenn L. Martin Company is now engaged in building many hundreds of these B26 bombers. Each of these ships is made up of 32 major assemblies which may be broken down into 650 minor assemblies, or 30,000 parts exclusive of the engines and standard components, such as nuts, bolts, and rivets.

Crawling about the well lighted loft floor, Martin designers lay out to full scale the sweeping contours of new aircraft on painted aluminum sheets

Photograph prints of bomber layouts are transferred to sheet steel to obtain templets and gages for shop use

Each of these parts must be processed through a series of manufacturing operations before it is ready for sub-assembly and final assembly.

The shape of each part is determined by the engineering department which is divided into three sections: development, stress and layout. A new but important group in the development section is the vibration division which has devised a novel way of analyzing vibration graphically to cure such bugaboos as wing flutter. These three sections determine the design of the ship through the application of aerodynamics, wind tunnel tests and the experience in bombing technique that is fast piling up. A



A look through the bellows of this giant camera shows a loft layout set up for photographic reproduction

fourth section of the engineering department, known as the release group, checks specifications, quantities and tracings for final release to the production department where orders, job tickets and blueprints are prepared for the shop.

An ideal way to work would be to wait until bomber designs had cleared through the release group before commencing tool design; but today's demand for speed in aircraft production does not permit such routine procedure. From the time a development project is undertaken, tool engineers work hand in hand with the design groups to determine the final shape of each part. They offer suggestions based on methods of manufacture, assembly, breakdowns for shipping, and a hundred and one processing considerations before the design is accepted. Since one unit of assembly affects another, once a chain of alterations is started, it progresses to other parts at the cost of precious days in getting into production. So tool engineering overlaps both the design and production department's functions of getting the orders into the shop. Thus the necessity for changes to obtain manufacturing economies after the design has been completed is avoided.

Since we have mentioned the production department, one unique phase of its activity should be noted. A photographic process has been developed at Glenn L. Martin to reproduce engineering drawings on sensitized surfaces of metal, wood, paper or plastic to either full scale, enlarged or reduced. Last year, it is estimated that the company saved over $80,000 in drafting alone through the use of this process. That is not all; engineering steps are speeded, tool design and toolmaking get going more rapidly and with greater accuracy, production starts sooner and changes are made with greater ease.

Since these gains are so desirable, it is well worth a minute or two to examine just how they are obtained. Martin engineers, borrowing their technique from ship designers, lay out new planes full size on a "loft" floor. The sweeping contours of wings and fuselage take shape here. They are detailed on aluminum sheets, painted white on one side to receive penciled layouts similar to those used for body design in the automobile industry. These sheets run up to 5x10 ft. in size.

Then the photographic process comes in. If a small scale wind tunnel model is needed, all parts of the plane can be reduced to scale photographically without any computation. Full scale reproductions may be made for the tool design department for making templets to be used in the shop.

One large saving is the making of right- and left-hand reproductions from a single loft drawing. Since a plane is symmetrical in most structural details, it is possible in this manner to obtain full scale reproductions of both sides from the layout of one.

Another function of the process is in making "shrink" layouts. Parts made in the drop hammer generally use dies of zinc or other soft metals. In making molds for these dies it was formerly necessary to allow for the shrinkage of the metal in cooling, either by special drawings or by means of a shrink scale. By a simple calibration of the camera it is now possible to make the lens allow for the shrink and thus obtain layouts from which die molds can be scaled direct.

Reproductions for use in making templets are often placed over steel sheets to which the contours are transferred by drilling a series of small holes

along the photographed lines. Other reproductions are sent to the wood shop where molds are built directly on them in order to follow the original contours without measurement. The use of coordinate dimensions, the transfer of lines by draftsmen, the stepping up or down in size by computation are all avoided by the use of this photographic technique.

Martin tool engineers decide just how a part is to be made. If it is a dural stiffener, the raw material consists of commercial sizes of sheet. The sheet is first sheared to a development templet obtained from experimental runs under the drop hammer. Holes are then drilled in the sheared pieces so that they can be stacked and fastened for cutting under a bandsaw. Some ten to fifteen sheets are held in this way, in order to trim away metal to obtain the final shape of the blank. Where large quantities are required, stamping dies for the complete blank may be made.

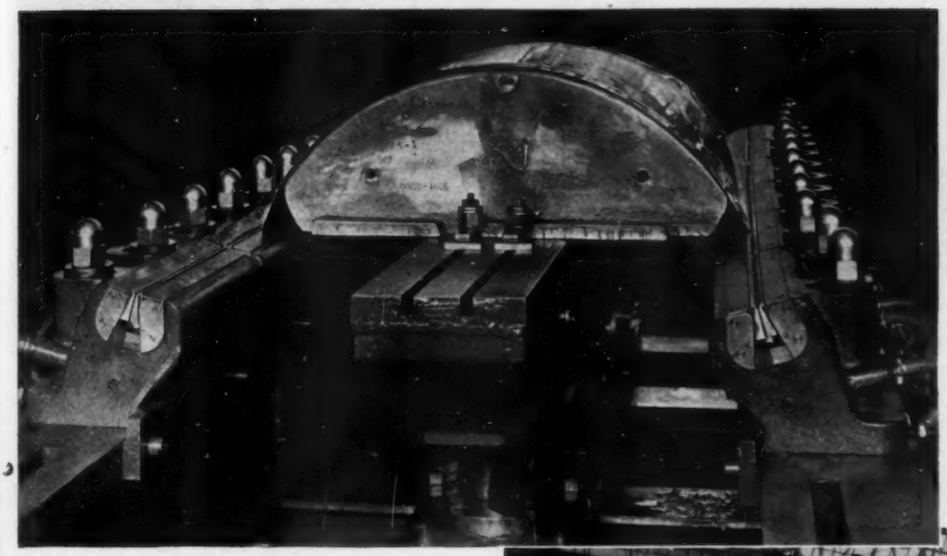
After burring, the blank is ready for forming. A number of methods are employed at the Martin plant, and it is up to the tool design department to decide which is best for a given piece. If the part is shaped only in one plane, it can be bent in a brake. If it has a uniform section and is curved in one plane only, the braking may be followed by a simple bending operation in one of the special machines designed for that purpose by Martin tool engineers.

But more often the part calls for irregular contours in several planes, often with reverse bends. Such pieces must be shaped in hydraulic presses or in drop hammers. The skin, or covering sheet of aluminum, is now formed for the most part in a stretching press. The machine used, a product of the Engineering Research Corporation, is designed to stretch the metal over a form or die having the required contour. The edges of the metal are clamped securely by wedging them between beveled shoes which are forced upward in tapered slots by air-operated plungers. Before the sheet is put in place, the form is fastened to a central beam, and the surface of the form is covered with a light grease so that the sheet metal can slip freely over it when the stretching takes place. The clamps are carried on adjustable supports, which are set with the jaws about parallel with the edges of the form and slightly further apart than the width of the form. The supports are then fastened to the bed of the machine.

Each of a pair of hydraulic cylinders built into the bed has a vertical plunger at the upper end, on which is a heavy pivot pin passing through the beam. At one side of the machine two control levers operate valves to raise and lower the hydraulic plungers. Facing the operator on the far side of the machine is a set of gages which show him the relative position of the plungers and how much pressure is being applied to each.

When the pressure is applied and the plungers move upward, the beam and form do likewise. If one plunger moves more than the other, the form

Sheet duralumin, the raw material for many bomber components, is first cut to size in a Niagara shear



Air-operated clamps grip the "skin" while a zinc alloy form mounted on a beam is forced upward by two hydraulic cylinders

By controlling the two hydraulic cylinders independently, the operator can tilt the beam at will as indicated by the instruments on the opposite side of the machine

and beam are tilted in the plane of the plunger axes, but if the plungers are moved the same distance the beam and form remain horizontal.

Once the sheet is clamped in place all the operator need do is to move the levers, and the form is lifted slowly until all slack in the sheet is taken up. By continuing the motion, the sheet is stretched and caused to assume the shape of the form. If the form is not crowned in planes parallel to the jaws, and the beam and form are not tilted, stretching will occur uniformly throughout the length of the sheet, provided the latter has the same initial slack at both ends. But by tilting the form stretching can be made to progress slowly from one end to the other. If the form is crowned longitudinally, stretching will normally start at the crest of the crown and proceed toward each end. Actual flow of the metal can be observed readily as the stretching proceeds.

Limiting devices are placed at each end of the beam so that the latter cannot be lifted beyond the setting which is made initially to give the sheet the stretch desired. When stretching is completed, the beam and form are lowered and the formed sheet is removed ready for trimming. Once the machine is set up, a stretching cycle, including loading and unloading, normally requires about two minutes.

The skill required for operation of the machine is not hard to acquire, and the piece is shaped in a fraction of the time needed for the hammering process formerly used. Some limitations as to the shape of the form exist.

Forms used in the Martin plant are made either

Plaster molds made from wooden forms are in turn used as patterns for the zinc alloy dies used in drop hammer operations

from hard wood, built to the required shape, and made as smooth as possible, or are cast, using SAE925 zinc alloy in a sand mold. Wooden forms are suited only for short runs, say for one to two dozen parts. Forms of zinc alloy may be used for much longer runs, and, of course, have greater strength and a harder surface which can easily be made smooth to permit relative motion between the form and the material stretched. Closer dimensional limits are thus possible with the metal form. However, thin sections with reverse bends cannot be formed by stretching, so these must go under the press or drop hammer.

Tools used in bomber manufacture are made either by the Martin toolroom which employs about 1,000 men, or by outside vendors, as decided by the tool engineering department. The choice depends on which will give greatest speed of production.

Some interesting techniques have been devised in making press tools. For example, the process of making drop hammer dies is started in the photographic department already described. Shrink layouts are sent to the wood shop where a mold is made by fastening a series of parallel templets to a common base and covering their edges with burlap. Thus, the burlap is made to assume the contour

Zinc alloy for making dies is melted in ladles heated in molden lead. The furnace at the extreme left is used to melt duralumin scrap

of the finished part. The form is sent to the press shop where it is inclosed with boards while plaster is poured on top of it. The resulting plaster pattern is used to make a sand mold in which dies of zinc, lead, aluminum, iron or steel can be cast.

Zinc molds are preferred for drop hammer work, as they give a desired compromise between ease of making and durability. Zinc is melted in two furnaces, which operate on the double-boiler principle. Heat is applied to an outer part containing lead and transferred through the molten lead to a ladle containing the zinc. It has been found that this furnace construction gives far greater life to the zinc ladles. It has the additional advantage of giving uniform heating which results in a purer metal for the dies.

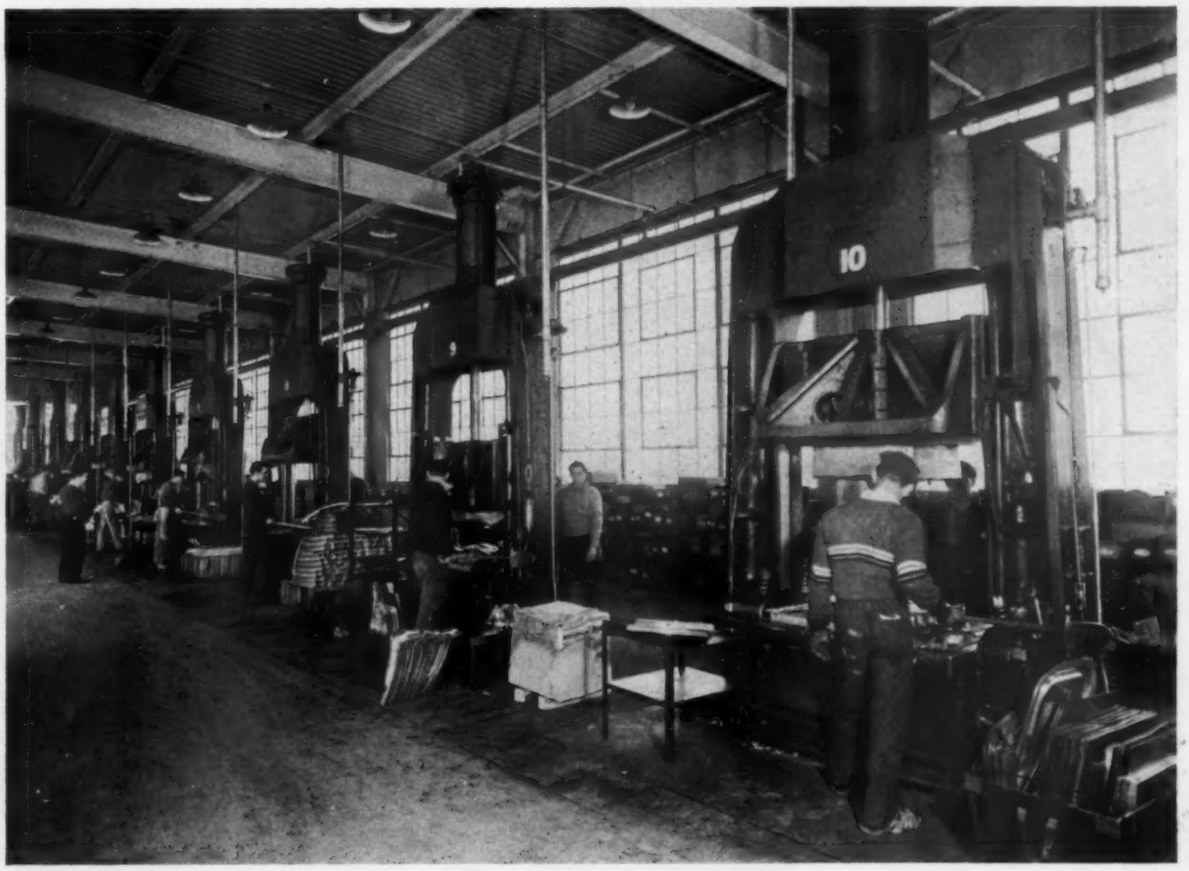
When the zinc is cast it is matched with the original form from which the plaster pattern was made. The form is covered with Prussian blue which shows the high spots when it is placed in contact with the zinc. The zinc is then scraped down until the form and the die match satisfactorily.

Often a lead punch is used with a zinc die. In this case the punch is cast right on top of the die, thus avoiding the necessity of making a second pattern.

For difficult shapes or high production runs, which

The Ceco stamp gives close control of striking force and has the additional advantage of quick operation. It is used on a wide variety of dural parts

The drop hammer department reflects good housekeeping; air-operated Ceco stamps predominate



Finishing touches may be given sheet dural parts on a Yoder hammer. This machine is also useful in hammering out special parts without the use of dies

For high production parts, large hydraulic presses are used. Soft metal dies in combination with rubber pads are suitable for most work. Where production warrants steel dies may be used

After forming, dural parts are heat-treated in a salt bath. A lag of one hour in hardening effect permits a restrike in the die to eliminate distortion

might cause severe die wear, cast steel or cast iron dies are resorted to. These are made by outside vendors from patterns supplied by Martin. In many instances, however, dies are made of scrap aluminum which can be melted in the drop hammer shop. Such dies give greater wear resistance than zinc and can be made by the same procedure.

The Martin drop hammer shop uses a number of rope hammers, but these are being superseded by pneumatically operated Ceco stamps which give a desirable combination of impact and squeeze. In addition, they can be controlled more easily and more accurately than the rope drop hammers. Eighteen of these machines have already been installed in the recently enlarged drop hammer shop.

For high production runs, hydraulic presses are becoming increasingly popular. These machines use metal dies over which rubber pads are pressed to give the sheet aluminum blanks their desired shape. For this purpose Glenn L. Martin has already installed six hydraulic presses.

After the parts come off the die, they are again checked with wooden check blocks. At this time the trim lines are marked on the edges and the surplus stock is cut off, using metal-cutting bandsaws. They are then burred on the bench with a hand file.

Then they are heat-treated. This step consists in heating in a salt bath and quenching in water. A peculiarity of duralumin is used to advantage by Martin tool engineers at this point. Some shapes may become distorted in heat-treating, but the full hardening effect of the heat-treatment does not take place until an hour after the piece is quenched. Therefore, parts subject to distortion can be restruck in the drop hammer die during this interval, restoring them to their desired shape while they are still ductile. The possibility of breakage caused by the increased hardness which heat-treating imparts is thus avoided.

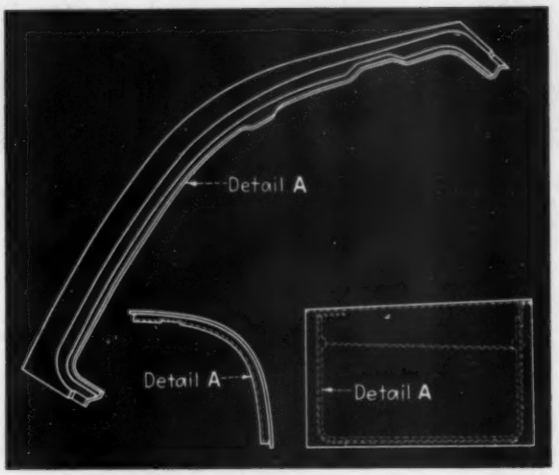
Parts, at this state of the process, usually go to the stockroom to be drawn out when the subassembly is started.

Let us take, for example, a part which Martin engineers call the upper venturi panel leading edge stiffener. This piece is one small component of the engine nacelle, the torpedo shaped structure that fits into the wing and carrier the engine. It will serve as an example of the 30,000 parts that go into the B26 bomber, because its manufacture is similar to many of the other duralumin details that make up the completed plane.

This particular stiffening piece is made of 0.040 in. thick duralumin by means of the drop hammer process just described. When it is withdrawn from stock it is subassembled with five other parts exclusive of rivets and other fasteners to make up a panel.

The upper venturi panel is made up of two vertical stiffeners, designated as leading and rear, three horizontal stiffeners, designated as upper, center and lower, respectively, and the skin. The stiffeners are assembled as a frame in a subassembly jig. This jig is made up of welded structural shapes and plates, and is formed to the same contour as the section of the cowl that the panel is to fit. This jig is arranged to take all five panels that go to make up the complete circumferential section of the cowl.

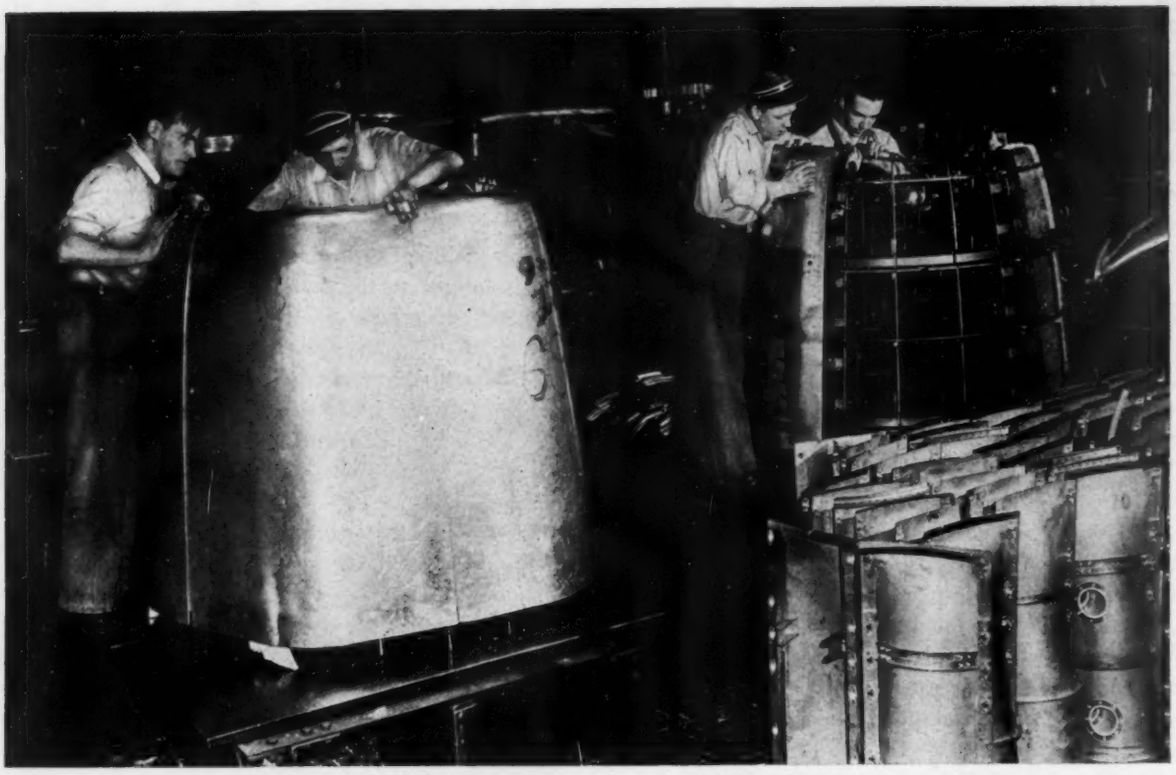
The stiffeners are placed in their proper positions first and are drilled with portable electric tools so that they can be bolted together. Then the skin is placed over the frame thus formed, fastened to it with small patented fasteners, and rivet holes are drilled through both skin and stiffeners.



Typical of the 30,000 parts which go into the B26 bomber is the venturi panel leading edge stiffener shown above

When this work has been completed the subassembly is removed from the jig. The skin is taken off the frame, which is carefully cleaned in Taseb and ten percent alcohol solution and then goes to a Sciacky welder. The frame joints are securely spot welded on this equipment which has been specifically developed for the welding of duralumin. The welded frame is then taken to a second jig, the skin fitted in place, and the rivets are inserted and headed with a portable squeeze riveter.

The assembled panel goes to a checking fixture which simulates the frame of the bombing plane itself. Here all the five panels are assembled at one time, using the same Dusz fasteners that are used in their final assembly to the finished ship. The purpose of this step is to make sure that all fastening holes contours and trim lines match the fixture and the



Panel parts are fitted on one of these jigs; then the stiffener members are dismounted, cleaned and welded before going to the second jig. The section shown is the cowl which goes ahead of the venturi section

adjacent panels to assure satisfactory fit in the final assembly. If the panels pass this test they are sent to final assembly stock.

Since the venturi panels are attached directly to the cowl supports, further jig assembly is not needed. Many parts of these planes, however, go through two sets of jigs: first for subassembly, and then for the final assembly. These venturi panels are among the last to be put on the ship. They are assembled after the engine has been installed, and then are buttoned down with Dusz fasteners.

For some subassemblies Glenn L. Martin has adopted a belt conveyor line along which machine and hand operations are performed; the pieces travel at a predetermined speed. Man-hours on these subassemblies have already been cut in half by use of the conveyor line and more extensive employment of this method is contemplated.

Two or more assemblymen, at the head of the belt, pace the line. Before them are the jigs into which the preformed pieces are fitted; they perform the first drilling operations with portable tools.

Pieces are then laid on the belt and go to drill presses where the remaining holes are jig drilled from the locating holes previously machined. Jig bushings are painted distinctive colors to indicate the size of the hole to be drilled.

Further along the line riveting machine operators fit the pieces together and rivet them. Thus the subassembly is built up in a series of steps until at the end of the line the unit is stamped with a part number and turned over to the inspector.

Martin's line assembly system is not limited to a single subassembly, but can take a number of units which have the same sequence of operations. The subassembly on the line can be changed at any time, or more than one type can be run through simultaneously. Another jig is simply added at the head of the line, and the operators along the line are shown what is to be done.

By means of the belt line the work that one or two men customarily did on a subassembly is broken up among a larger number of men each of whom performs one type of operation.

It has been found that this system improves quality and saves time. A man who does one type of job or operates one type of machine is less likely to make errors than the man who does a variety of work.

Of equal importance is the use of men of lesser skill as aircraft workers, freeing highly skilled men for more exacting duties.

Some idea of the attention to small details needed in building even so large a product as a bombing plane may be gained from Glenn L. Martin's handling of rivets. Since the riveters are busy on putting the planes together, they can hardly be expected

to retrieve those that slip through their fingers—indeed, they are prohibited from doing so. Needless to say, thousands of them reach the floor instead of the panel for which they were intended, and at the end of a day those swept up formerly constituted a real problem. Their value averages over one dollar a pound, and some 60 lb. are swept up daily.

Hand sorting was attempted, but it was found that youngsters working on the rivets could not save enough to earn their pay. The tool design department was called in to devise machinery to salvage rivets. Now the machinery is in operation.

The first step is to pass an electromagnet over the sweepings to remove steel and iron scrap. What remains is chiefly 150 different types of rivets. These are sorted as to diameter by passing through a series of sifters which use parallel bars instead of screens. This gives the initial classification as to size. But there are still variations in length and head shape.

The next machine provides a hopper and a track along which the rivets are carried for head shape sorting. Round heads are carried into one pan and flat heads into another, leaving only the question of length to be settled. This is done in a sort of a merry-go-around arrangement. The rivets are slid down along slides with a slot in the center, which causes them to hang upright. They pass from the slide to the periphery of a notched wheel which car-

New to aircraft manufacture is the moving belt assembly line. Martin tool engineers have successfully adopted this automotive practice to meet the needs of their particular kind of product

Finally the panel is assembled to the bomber. This particular part covers the cowl support and is one of the last to be assembled

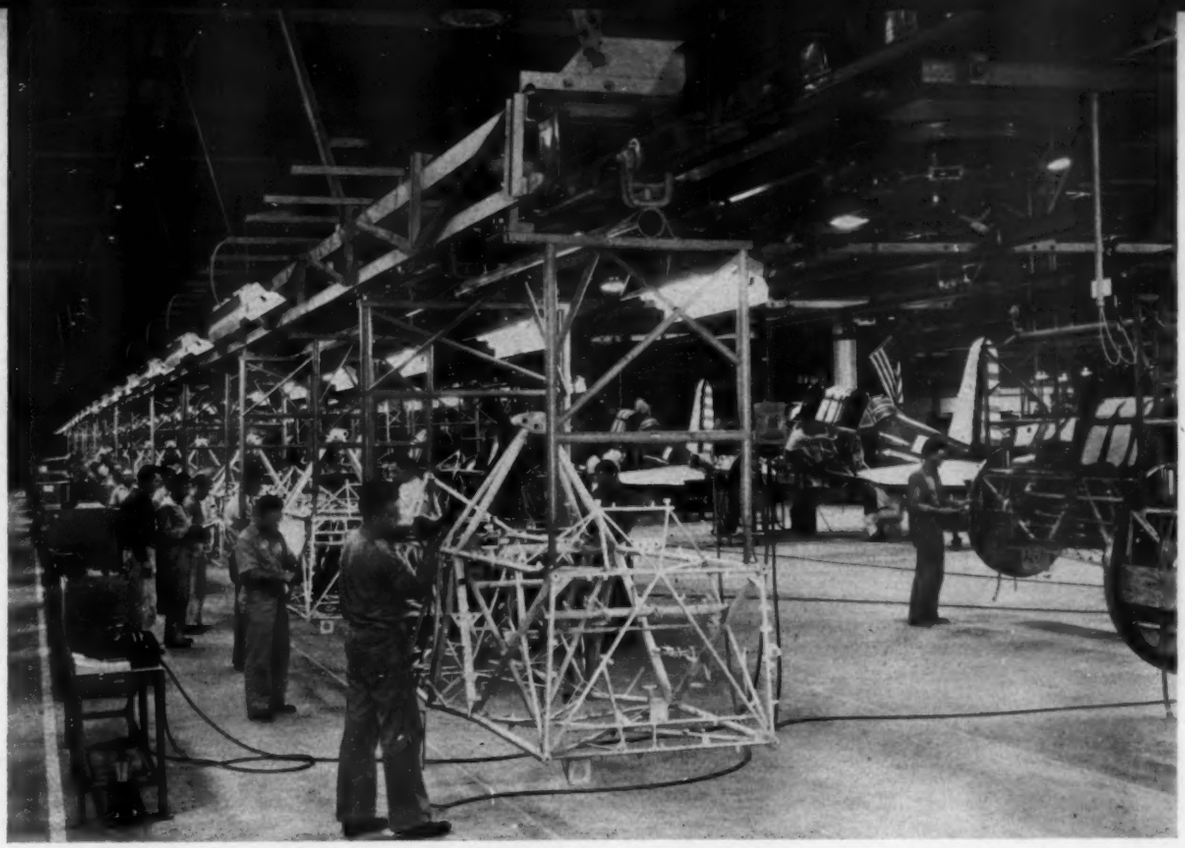
An intermediate step is sorting according to head size. Since this head selector works twice as fast as the length selector the whole operation is speeded up

Rivets take a ride around a mechanical merry-go-round and are knocked off by projecting springs according to their length

ries them over a series of bins placed around its circumference. At the first bin either flat or round-head rivets are knocked off the wheel, according to the type being sorted. This arrangement could be used to eliminate the head sorting machine, but it speeds up operation to do that step separately because the head-selector is twice as fast as the length selector. As the rivets hang down from the notches of the wheel they pass over a series of springs adjusted to a different height for each bin. The long rivets are knocked off first, while the shorter ones pass safely over the projecting spring. As they come to successive bins the obstacles are placed higher and higher, until all rivets are knocked out according to their length. This operation turns back to the company each year some $12,500 worth of rivets at a cost of about $3,000.

Stupendous as Martin operations are at present, they are soon to become much greater. Under construction now are a second plant at Middle River and a third at Omaha, Nebr. Together, these two, with the newly enlarged main plant, will total nearly 5,200,000 sq.ft. of floor space.

At the Omaha plant the company will assemble Martin bombers from subassemblies and parts supplied from automotive and other manufacturers. By next spring the Middle River plant alone will employ some 42,000 men as compared to 18,000 at present.



Fuselage frames enter on the left of the assembly line. Parts and sub-assemblies are added as the frames proceed around the U-shaped conveyor. They are then shifted across to the final assembly line

CONVEYORS SPEED PLANE PRODUCTION

BY R. B. PARKHURST

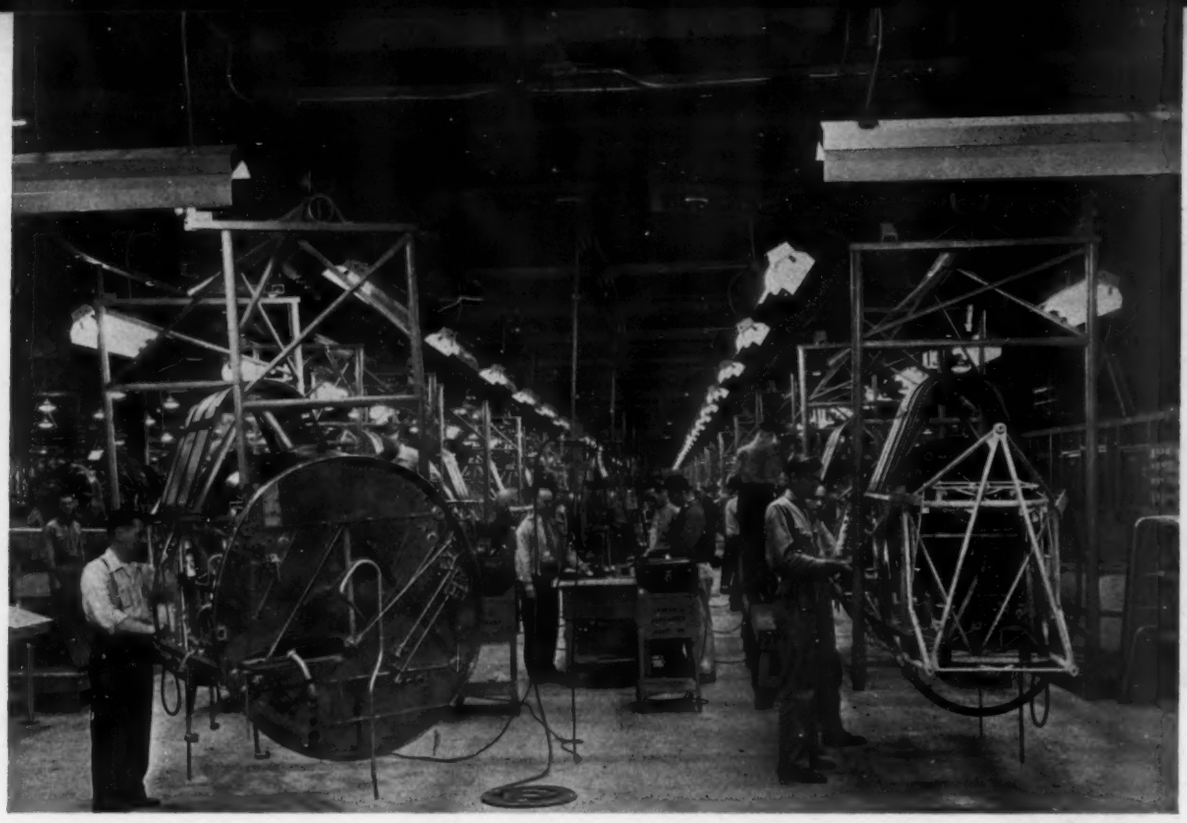
Chief Industrial Engineer, Vultee Field Division, Vultee Aircraft, Inc.

USE OF POWERED assembly lines in the Vultee Field plant of Vultee Aircraft is outward evidence of a "behind-the-scenes" production speed-up made possible by the award of contracts to build a large number of training planes of a single type. With receipt of such orders, immediate studies were instituted, and are still in progress, seeking to apply the most modern information on time and motion efficiency to our production problem. Coupled with these studies is the application of every possible mechanical handling aid to the production cycle.

As a result we have in operation a powered final assembly conveyor line which is slashing to ribbons the best previous production records. This conveyor line has been fed back into the plant to serve every possible department as our studies progress. Already there is a total of 6,280 ft. of overhead mechanical conveyor track, as compared with the powered portion of the final assembly line which is 650 ft. long. We are making use of other handling systems, and will soon place in operation a gravity roller-conveyor system in connection with certain small parts processing operations.

In order to describe the present conveyor system it is necessary to list the major sub-assemblies which are mechanically handled. The complete airplane is treated as five major sub-assemblies which come together in the following sequence: main fuselage, monocoque tail section, wing center section, engine section and outer wing sections. There are a large number of minor sub-assemblies which are incorporated in the plane during the assembly operation, but the above named units each is handled by a separate mechanical conveyor line.

Since the main fuselage is the heart of the airplane, or the backbone to which all other members are



When the fuselage frames reach the closed end of the U-shaped conveyor, instruments, plumbing, wiring, controls and canopy have been installed. Note how the frame carriers are stabilized to a parallel side rail

attached, it is logical to gear the assembly operation to it. This part of the airplane structure is an open-truss skeleton of welded steel tubing which is readily accessible for mounting controls, wiring and plumbing. The fuselage structure comes from its fabrication department on an overhead conveyor and is fed into the powered portion of our final assembly line. As the fuselage progresses down one leg of the U-shaped line and back up the other it acquires many parts and sub-assemblies. After traversing the U-section the fuselage moves across to the final assembly line which leads straight out to the hangar doors opening on the flying field.

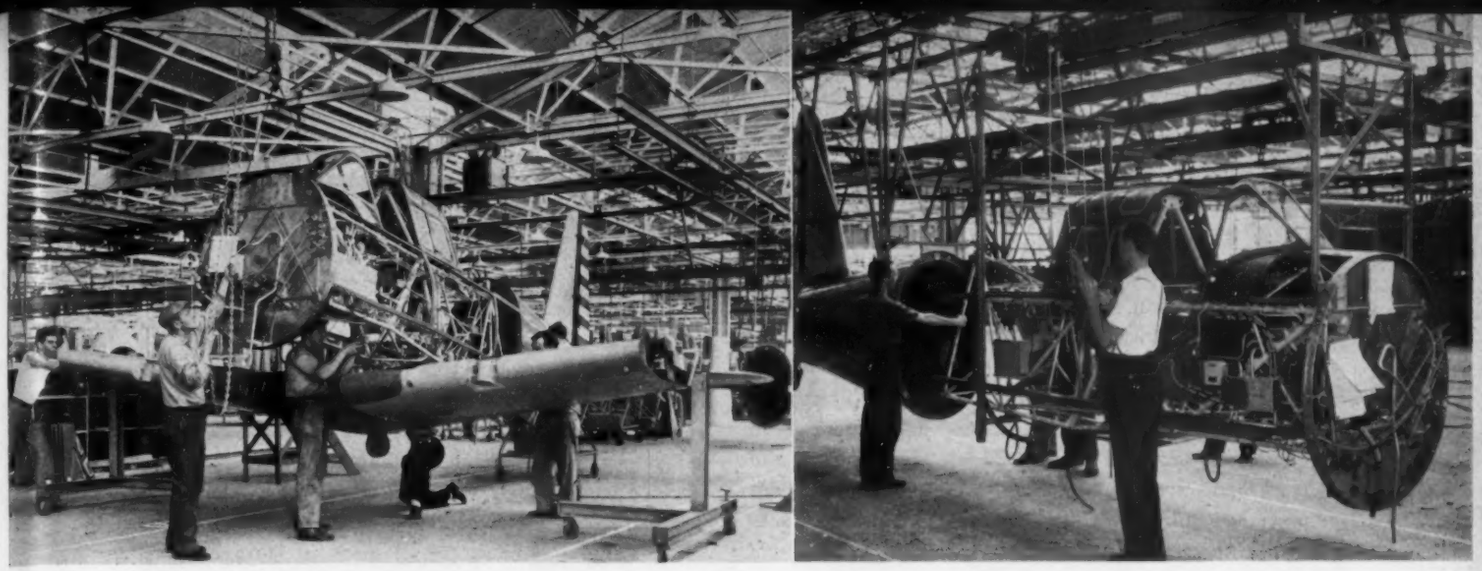
At the head of this final assembly line the fuselage is mated with the tail cone section, which feeds in from another conveyor line along which it has had the tail control surfaces and tail wheel attached. Only three bolts are required in attaching the tail cone, which is a monocoque structure of aluminum sheet, to the fuselage proper. The fuselage is then mated with the wing center section which is accomplished by four bolts. The center section carries the landing gear and at present the planes are rolled forward under their own power from this point on the final assembly line. Soon, however, we will have a powered line running to the hangar door.

After attachment of the center section the plane progresses to the engine attachment position. Here the engine is dropped down by a power hoist from a controllable powered line overhead which feeds completed engine section assemblies from a conveyor line located on a balcony above the assembly floor.

Right and left wing panels are fed in from overhead conveyors and are the last major units to be attached prior to completion of the plane. These wing panels, and the center section, are positioned on special carriers which are routed through the paint shop on overhead conveyor lines for finish painting following fabrication. Each wing panel, and the center section, is carried along a conveyor line during assembly operations in its own department. At the moment we are in the process of completing the wing department conveyor lines, having started the final assembly line prior to extension of the conveyor system into the wing fabrication area of the plant.

Returning to the powered portion of the final assembly line we find several notable features. Structurally the conveyor system is a monorail, with a stabilizing rail along the outside of the U-shaped line. The monorail and conveyor chain are mounted on a truss structure hung from the roof trusses. Floor to ceiling clearance is about 30 ft. but our conveyor system monorail is located down about 10 ft. above floor level for convenience and stability. Even when the conveyor is carrying a full load of fuselages the roof trusses are not loaded to more than 50 per cent of their design limit.

A primary feature of this method of slinging the assembly line from the ceiling is that it leaves the floor completely clear for use of the workmen. They are able to reach all portions of the fuselage structure without hindrance from either side, from beneath, or from above. Each fuselage is carried in an indi-



Above—The center section of the wing is attached to the fuselage at station No. 2 on the final assembly line. The engine is added at station No. 3. *At right*—At the head of the final assembly line, the monocoque fuselage tail section is mated with the main fuselage structure. This is done through the use of three bolts

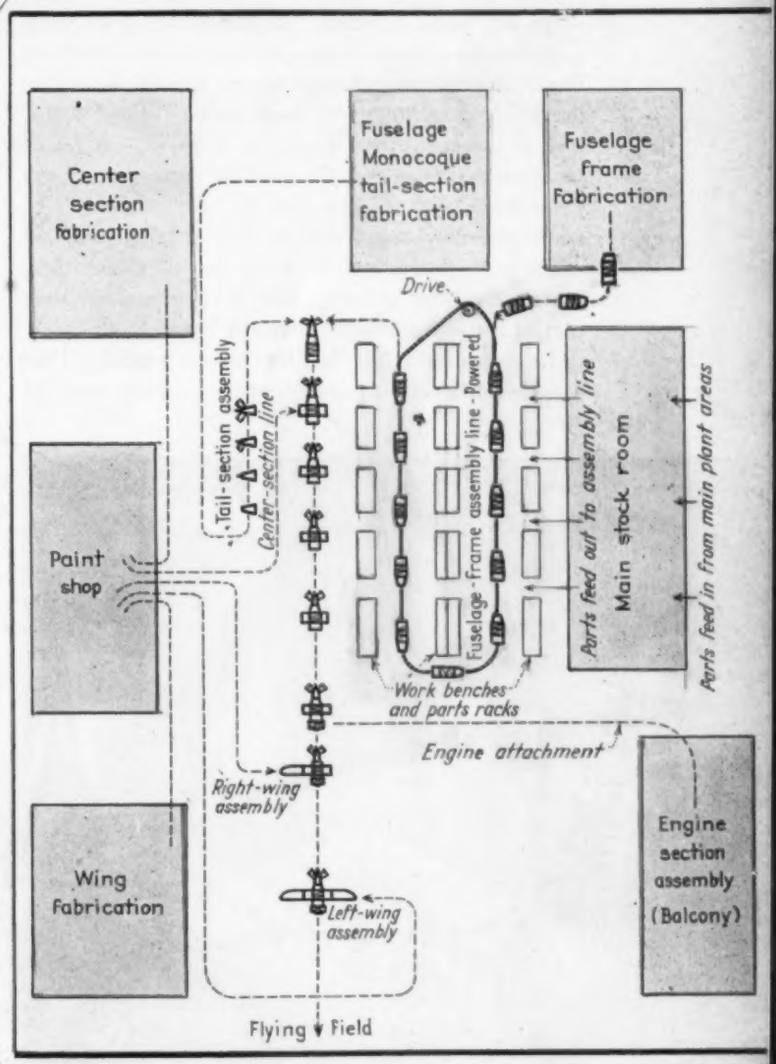
vidual completely stabilized carrier frame. The rollers which brace this frame to the stabilizing rail prevent the fuselage from swinging when being worked on. Various types of stock racks, stands, and benches are used at the various stations to facilitate the positioning of material and working tools used for assembly operations. There are a total of twenty-five stations of which twenty-one are work stations and four are used for inspection.

The carrier racks are driven by a heavy link chain which runs over a powered sprocket located in the open end of the U-shaped lines. Power is supplied by a Sterling Speed-Trol ½-hp. electric motor driving through a gear-reduction system which permits varying the speed of the line from 5 to 30 ft. per hr. For reasons of national defense we are not permitted to divulge the speed at which the line operates.

Since operations are carried on both day and night it was necessary to devise a special lighting installation. In addition to the regular incandescent overhead lamps, located at the height of the roof trusses, we have installed four banks of fluorescent lamps, one along each side of each leg of the assembly line. These provide ideal working light all hours of day and night.

Stock parts and sub-assemblies are fed to this line from the main stockroom, which is located along one side of the line. From the stockroom parts are supplied to the four rows of racks and benches from which the assembly mechanics work. Each station has its own racks, which are fixed in place and are supplied with parts by stockroom deliverymen.

The materials supplied are of two classifications: (1) Open stock which includes standard expendible items such as nuts, bolts, rivets, washers, etc. (2) More important parts and assemblies which are handled against drawing numbers. A parts list is provided at each station for ready reference on the part of the crew. An assembly chart also accom-



The conveyor system of handling plane parts in the Vultee aircraft factory is designed around moving fuselage assembly and final production lines. Precisely scheduled sub-assemblies feed the main lines

panies each plane and serves as reference for mechanics and inspectors, being initialed on completion of each operation. Such organization of the assembly line makes it practicable to break in new men in two weeks time and minimizes the need for skilled help.

The monocoque tail sections feed into a separate assembly line from their fabrication department. On this line they are carried along double overhead tracks and are supported on racks. The line is not powered, but brakes are provided to hold the racks firmly at each station. After receiving the fin and rudder assembly, and the stabilizer and elevator assemblies, the tail cone feeds out to the head of the final assembly line.

A major feature of the conveyor system is the manner in which assemblies are fed through the paint shops for finish painting. In the paint shops there is a complex system of conveyor lines within conveyor lines. A powered conveyor system is continuously in operation carrying parts past various spray booths and at the same time serving as a dryer. A set of switches makes it possible to shift parts around the paint shop with a minimum of lost motion. An automatic powered conveyor also carries racks of small parts past a row of spray booths where these parts are painted at a high rate of speed and are then carried through banks of infra-red lamps.

In view of the fact that the various assembly lines are operated and controlled so as to meet required production schedules, the balance of all other departments of the factory, such as machine shop, fabrication, and processing, must be scheduled accordingly. In this period of a national defense emergency it is not permissible to build up a large stock of parts for assembly. Therefore, it is desirable to work on the minimum quantity of stored parts, or with the lowest possible margin. While we cannot specify the time cycle during which we convert raw materials into finished airplanes, it can be said that the OPM imposes a 120 day limit on all material storage. We try to operate against a 100-plane margin in the small parts category. But on major items we work much closer to the margin than this, rarely having a margin of more than one or two days supply of completed fuselage frames, for example.

The powered assembly line in an aircraft factory must not only be subject to fairly wide changes in speed of operation and to accommodate changing models and conditions, but the various conveyor lines must be laid out with the thought of change in mind as future models are fed into the system.

Our installation of overhead conveyor lines has reduced required floor space by 33 per cent and has speeded assembly operations 50 per cent. We have provided a total of 124 individual carriers, some of sling type, some of suspension arm kind, and some equipped with trays. A total of 123,000 lb. of steel is involved in the supports and rail for the conveyor system. But back of the conveyor lines is an imposing assembly of specialized equipment all arranged to provide maximum efficiency in the flow of parts through fabrication and processing departments to final assembly.

In the press department we have a 2400-ton Birdsboro hydraulic press with revolving table for positioning work on the dies while pressing operations are in progress. And there is a 350-ton Minster mechanical press, plus a battery of 150-ton presses of this type. Automatic riveting and punching machines are widely used. Electric arc welding in the fuselage department has cut 25 per cent from the time formerly required for acetylene welding. In the heat-treating department a salt-bath furnace installation has overhead handling equipment with a lifting speed of 125 ft. per min. which can plunge whole racks of aircraft parts into the 48,000 lb. of molten salt at a temperature of 925 F., and hoist them out into the tempering tank at the rate of 1,200 lb. per hr.

All of these and many more operations have been successfully geared to the powered assembly line. But it is important to remember that this is possible because Vultee is working on the largest order for planes of a single type that has ever been placed in America.

Conveyor systems are used extensively in sub-assembly departments. Here banks of infra-red lamps are used for quick drying of small parts carried through the paint booths on specially designed carriers

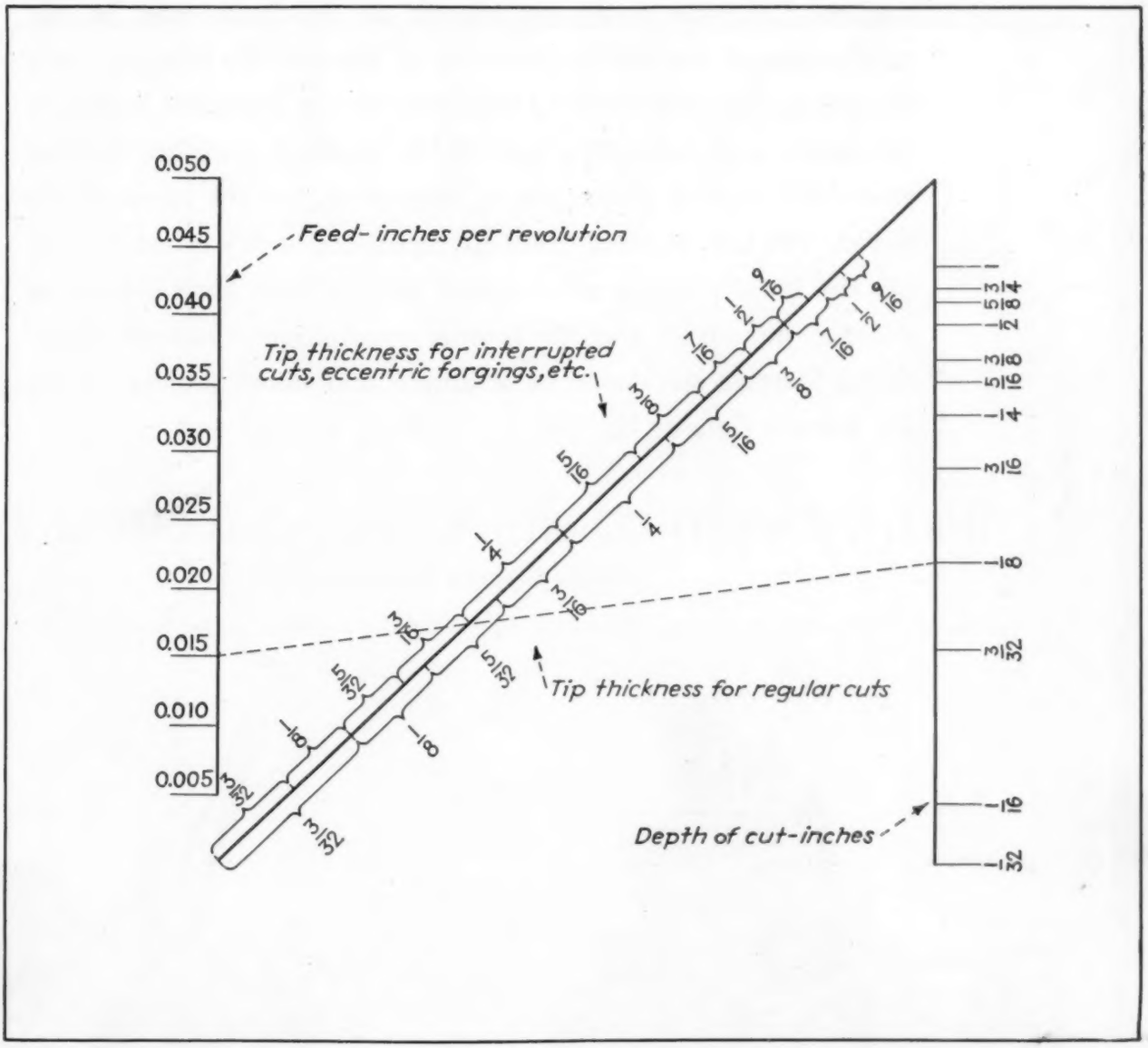
AMERICAN MACHINIST REFERENCE BOOK SHEET

Optimum Tip Thickness for Carbide Tools

BY PAUL H. MILLER, CARBOLOY COMPANY

THICKNESS OF TIPS for carbide tools to be used on a given job cannot be calculated with absolute certainty. To derive the accompanying nomograph, a series of calculations were made and adjusted from actual experience. Loading of the tip depends upon depth of cut and feed, but experience shows that cutting speed does not play an important part in tip loading and may be neglected. With this nomograph it is possible to determine the safe tip thickness to be used for most tools. A chart of this kind will not exactly cover every condition; thinner tips can be used for jobs where cutting stress is low, and an extremely tough job may require thicker tips.

To use this nomograph—Draw a line from proper point on feed scale to proper point on depth-of-cut scale. At intersection of this construction line with the tip-thickness scale, read value for tip thickness for either continuous or interrupted cutting. Example: feed, 0.015 in., depth of cut, $\frac{1}{8}$ in. At intersection of dash line with tip-thickness scale, it is seen that continuous cutting calls for a tip thickness of $\frac{5}{32}$ in.; for interrupted cutting, $\frac{1}{4}$ in. is best.



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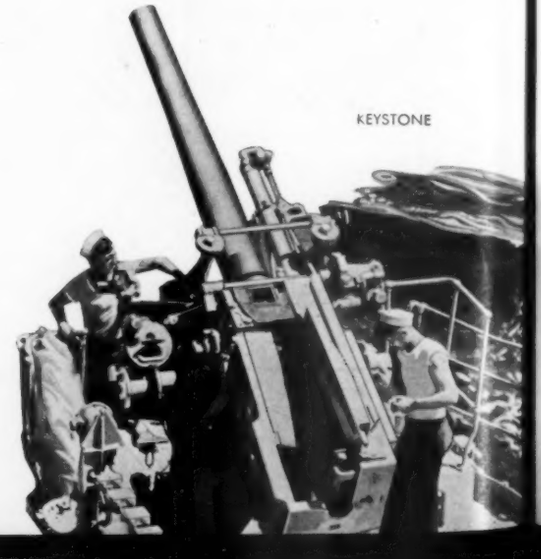


KEYSTONE

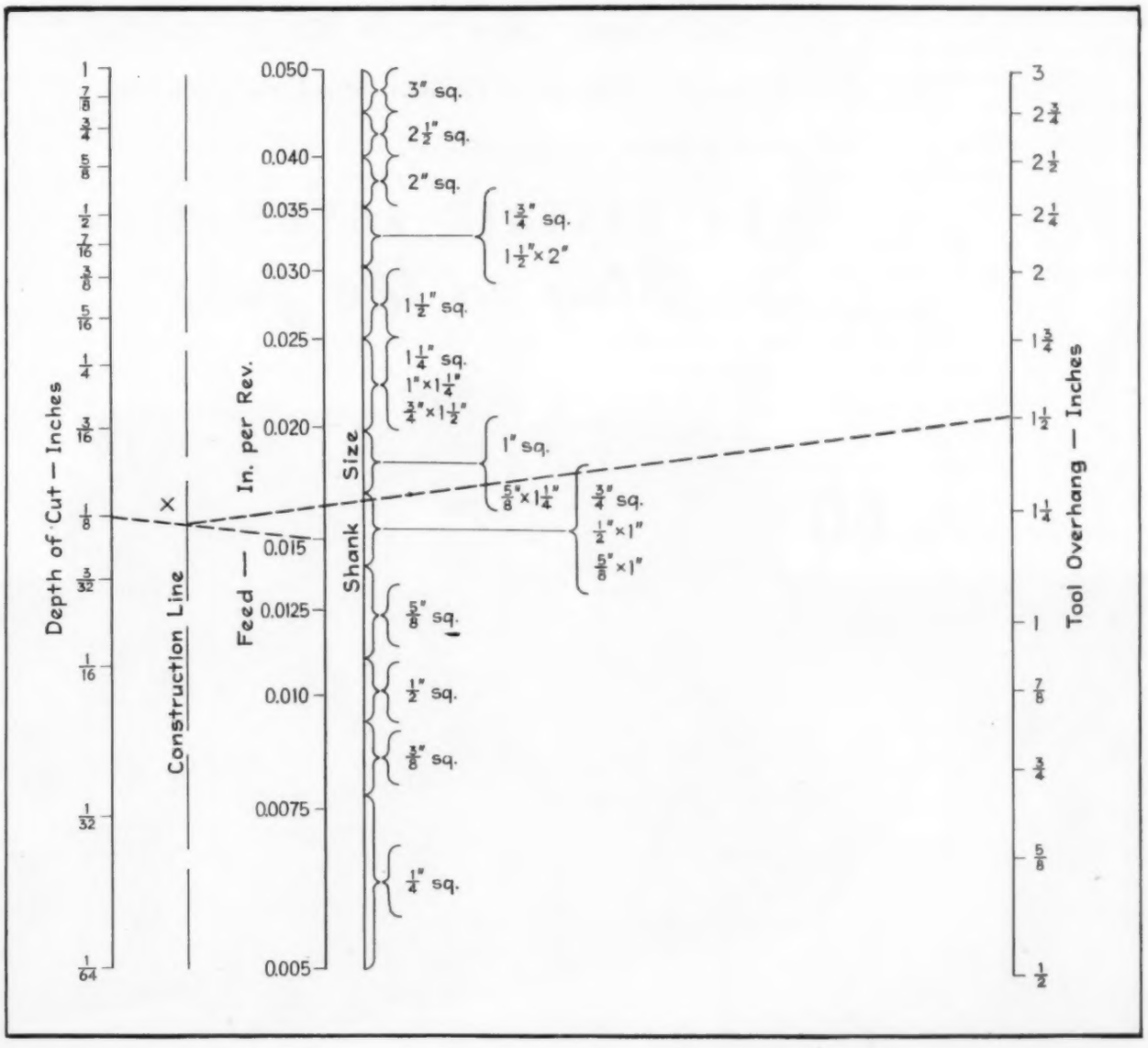
AMERICAN MACHINIST REFERENCE BOOK SHEET

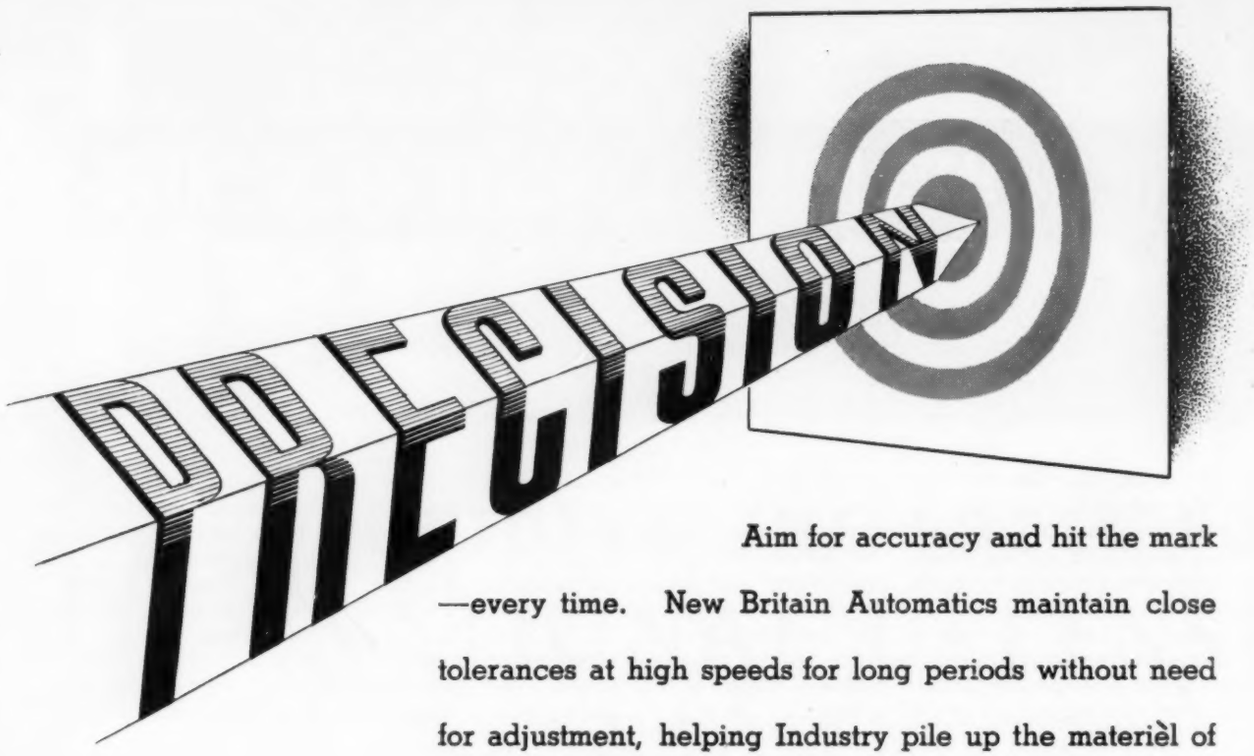
Shank Size of Carbide Tools

BY PAUL H. MILLER, CARBOLOY COMPANY

MUCH HAS BEEN SAID about using heavy shanks and rigid setups in order to get the lowest possible part cost when machining with carbide tools. General statements have been variously interpreted. From a study of field applications, and checked by calculations of actual loads imposed upon tools while cutting, the accompanying nomograph has been constructed, so that the tool designer can select a suitable shank size for a given set of conditions. Three factors must be known: depth of cut and the feed, which determine the load on the tool, and the overhang, which determines the bending moment that the shank must resist.

To use the nomograph, proceed as follows: Assume a feed of 0.015 in., a depth of cut of $\frac{1}{8}$ in., and an overhang of $1\frac{1}{2}$ in. Draw a dash line from the $\frac{1}{8}$ in. value on the depth-of-cut scale to the 0.015 in. value on the feed scale. This line intersects the "construction" line at *X*. Connect *X* with the $1\frac{1}{2}$ in. value on the tool-overhang scale. Read the proper shank size where this second dash line intersects the shank-size scale. In this case, the shank size is $\frac{3}{4}$ in. square, or $\frac{1}{2}$ x 1 in.





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A complete line of Multiple Spindle Screw Machines up to 2¼" Capacity.
Also a complete line of Chuckers . . . Four, Six and Eight Spindles to 10¼" Capacity.

"V" For Victory

LAST DECEMBER 11 officials of the Bullard Company met with defense authorities and were asked to erect a new assembly plant for production of machine tools. Within ten days the engineering work was done and a formal proposal had been submitted to Washington.

Exactly thirty days later the War Department's approval came through and a letter of intent was forwarded to the Bullard Company. The management cut red tape, and things began to happen. There was no waiting for a written contract.

The upshot was that a huge new factory occupying over three acres of productive floor space went up in double-quick time. It was turning out machine tools by July 15. Inspecting the plant last week a visitor might have thought that it had been operating for months. Not until after the plant was completed did the formal contract arrive from Washington.

The job of constructing the building, equipping and manning it and getting production started had been so beautifully done that at the housewarming on July 28, though all speeches had been specifically forbidden, a representative of the War Department felt impelled to tell the assembled guests what a magnificent job Bullard had done.

What a superb example for people to point to who contend that in our defense efforts "it is later than we think." No hesitancy, no debating over whether to do what the government wanted done, no tepid approach to the problem. Only an all-out plunge would suffice; and that plunge was taken.

Yet this is no isolated case. Other machine tool builders, recognizing the national emergency, have gone ahead with comparable programs with dispatch and efficiency. They were among the first to respond when Washington called for expansion of the country's productive facilities.

The Navy "E," which for more than thirty years has denoted "excellence and efficiency" in ship operation, is now being awarded by the Navy Department to companies which are ahead of or on schedule in the production of ordnance equipment vital to the Navy's expansion.

Not until the country as a whole and all of American industry get that infectious spirit which most of our industrialists possess—the kind of spirit which led Admiral Farragut to shout "Damn the torpedoes, full speed ahead"—will we really get places fast in the race against time to arm ourselves and thereby preserve our own freedom. The more plants that merit "E" in the defense program, whether they are working for the Army or the Navy or both, the faster the country itself will achieve "V." And everybody should know by this time that "V" stands for "Victory."

Burnham Finney

GAGING BUSINESS

New appropriation to speed transition of metal-working industry onto defense basis. Bomber program to take fewer tools than estimated. Plane propeller shortage will soon be eased

Passage of the huge supplemental defense appropriation bill by Congress should provide money to put much more of the non-defense metal-working companies to work on munitions manufacture. A billion and a half is for new ordnance items, such as tanks, scout cars and anti-aircraft equipment. And the government's intention is to refrain from building new plants and take up the additional load by displacement of existing civilian production. Thus the transition of the industry from non-defense to defense operations should be hastened.

Machine Tools—Production of machine tools continues to expand as new plants come into operation, more work is farmed out, hours are lengthened and more men are employed. Daily output is now well over the 1,000-tools-a-day figure attained three months ago. The defense load is not equally distributed throughout the industry, hence some companies can still take orders for delivery in November and December. Anti-aircraft plants and airplane factories continue to need machine tools most urgently of all defense buyers. The 500-a-month bomber program, for which few awards have been left to prime contractors, is slow in reaching machine tool builders. Revised estimates indicate that far fewer machine tools will be required for this program than the $425,000,000 originally predicted. Many builders are proceeding with the manufacture of machines on the strength of letters of intent or verbal orders from OPM rather than on the basis of written contracts. The shift of some aircraft engine makers, such as Studebaker, from one size and type of motor to another has delayed engine production and caused a slowing down in deliveries of tools to these customers because of necessary last-minute changes. Allis-Chalmers and Fairbanks, Morse are reported figuring on large new defense contracts which will require many machine tools.

Farm Equipment—The highest civilian preference rating has been given deliveries of materials to farm machinery makers during August, September and October. The object is to insure the nation's food supply at a time when farm labor is becoming scarce and more mechanical equipment is needed. Deliveries are not to be more than 20 per cent above those in 1940 or 1939, whichever was higher. Preferences are not to be used to accumulate inventories.

Steel—OPM has asked the steel industry to triple its supply of fabricated alloy steel for aircraft by increasing heat treating and finishing capacity and by allocation of orders rather than by enlarging further electric furnace melting capacity. Pig iron facilities will be increased 6,500,000 tons annually by erection of new blast furnaces by five companies. Talk about construction of 10,000,000 tons of steel-making capacity continues. The shortage of scrap has become so acute that unless it can be relieved soon it will seriously affect steel production.

Shipbuilding—Twelve hundred merchant ships are now on contract with U. S. yards. On July 30 the one hundredth ship in the Maritime Commission's long-range program was delivered to its operator. The first ship was contracted for Oct. 21, 1937. Three hundred ninety-three "C" ships have been ordered, 156 keels laid, 123 vessels launched and 100 delivered. Keels of 27 "EC-2" emergency ships have been laid. The Commission has designed a small coastal diesel tanker with capacity of 12,800 barrels each. Bids have been asked on 16. Not more than six will be awarded to one bidder. Eighty-three tankers of regular design are now under contract.

Aircraft—The defense program, including the heavy bomber schedule, calls for airplane output totaling $11,469,000,000. Actual awards, representing the industry's backlog, amount to $6,122,000,000. One of the tightest spots is propeller manufacture. It will be eased within a few months by production of the new General Motors propeller at the corporation's Aeroproducts Division at Dayton, Ohio, and by the arrangement under which Nash-Kelvinator will make propellers under license. Biggest difficulty seems to be manufacture of blades for the largest size propellers. Actually, some plants where acceleration of plane production has not been rapid have built up large backlogs of propellers.

Munitions—In the last ninety days machine gun production has risen 93 per cent, light tanks 475 per cent, medium tanks 467 per cent and smokeless powder 127 per cent. Output of rifles and machine guns (semi-automatic Garands, automatic Brownings and submachine gun Thompsons) is now 1,500 a day, against 931 in January. American Car & Foundry has received a new order for 629 light tanks. Last Saturday it delivered to Uncle Sam its one thousandth tank. Production is 10–15 tanks a day. Ordnance manufacture is sufficiently far along that no ships will be delayed for lack of armament. Some anti-aircraft equipment is behind schedule.

SMALL TOOLS NOW COVERED BY PRIORITY RATING

Cutters and grinding wheels brought under OPM control. Dealer orders for stock are banned. Provision made for completion of work on current orders. Restrictions put on additional materials

By ROBERT COLBURN

WASHINGTON — Cutting tools and grinding wheels have been brought under substantially the same priority controls as machine tools, under an order issued last month. Except by special permission, producers and distributors may make deliveries only on orders which bear a preference rating; they may, however, arbitrarily assign a rating of A-10 to unrated orders which they know to be for defense—that is to say, orders placed by Army, Navy, Maritime Commission, Coast and Geodetic Survey, Coast Guard, Civil Aeronautics Authority, National Advisory Committee for Aeronautics, National Defense Research Council, the British and users who need tools to fill orders placed by these agencies.

Defense orders are made semi-compulsory under a rule that such orders must be accepted in preference to other orders on similar terms.

The order covers special (not listed in catalogs) drills, taps, reamers and milling cutters, and all types of the following tools: oil-tube and oil-hole drills, countersinks, counterbores, hobs, high-speed taps, high-speed chasers for self-opening die heads and for collapsing taps, machine broaches and cemented-carbide tools.

Distributors may make deliveries from stock only on defense orders and may not in future order tools for stock. Tool users, therefore, must give distributors advance notice of needs.

The impact of this priority order on manufacturers is somewhat eased by two modifications. As a permanent thing, a ten-day period of grace, similar to that granted machine tool builders, is established. This means that when a high-priority order comes in, manufacturing operations already underway need not be interrupted for ten days. An exception is made for orders with the AA (emergency) rating, which must always receive immediate attention.

A second concession provides that for a period of six weeks after July 17 work may be continued and deliveries made on orders which were in production on that date. An exception is again made for AA ratings.

The order provides that tool users with priority ratings who feel they are not getting the deliveries to which they are entitled and manufacturers or users who feel they are being subjected by the order to unreasonable hardship may complain to the Division of Priorities, attention Tools and Equipment group, Office of Production Management, Washington.

Other priority actions of the fortnight:

Starting in September, all deliveries of calcium-silicon, steel alloying agent, will be subject to detailed allocation by OPM. August deliveries may be made as scheduled.

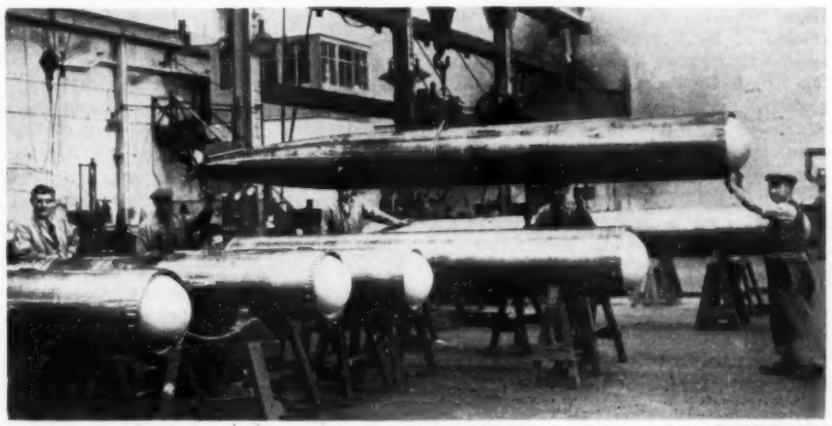
Blanket ratings of A-3 were assigned to about 40 builders of mining machinery and to 10 locomotive builders and 60 locomotive repair plants. These eliminate the red tape of getting separate ratings on each order.

Office of Price Administration and Civilian Supply ordered that orders for raw materials going into hospital apparatus and equipment, surgical implements, eyeglass frames, and for tinplate and zinc oxide for cans to pack the current food crops be given preference over other civilian orders. Like most OPACS priority actions, these do not mean a great deal until OPM moves to give them effect.

OPACS has also directed OPM to assign specified monthly tonnages of metal to manufacturers of thermostatic bi-metal for temperature control devices.

To aid in accumulation of a stockpile, tin consumers were asked to stop buying metal until the increases in the tin inventories over those on hand in June, 1940, is cut in half.

Priorities Division is holding one-day training courses for business and industrial priorities specialists. First was for men from the steel industry, second for trade association executives. Meetings angled towards other industries will be announced later. Mason Manghum of OPM is in charge of the program.



British Combine

Steel Fish—*To keep open Great Britain's life line and secure much needed munitions and supplies from this side of the Atlantic, this British plant is turning out torpedoes. Here they are being fitted with their war heads*

HILLMAN ORGANIZES LSD

WASHINGTON — Sidney Hillman has in operation a new labor supply set-up for defense. He has combined the work of twelve government agencies concerned with skill supply into a new Labor Supply Division, within OPM's Labor Division. LSD is headed by Commissioner Arthur S. Fleming of the Civil Service Commission.

LSD has twelve Regional Labor Supply Committees. The chairman of each Committee is the regional representative of the Bureau of Employment Security, which is part of the Federal Security Agency—and the *region* is one of the twelve divisions of FSA.

It sounds like a tangle of bureaus, but it's not bad as Washington goes. Actually, what it amounts to is this: The United States Employment Service, which is composed of the 1500 state employment services, has been designated as official points of contact with industry on employment.

This is how it works. Your plant has defense contracts, and you are short of certain skilled labor. You report to the nearest state employment office. The U. S. Employment Service looks at its records of your region, checks to make sure you have tried all local sources. If so, workers out of jobs or in the wrong jobs are brought in by the U. S. Employment Service.

LSD aims at preventive cures—that is, it tries to regulate training under the Office of Education, and migration, sniping and the future demand for skills, so that shortages and unemployment are reduced to a minimum.

Bullard Builds—*This new assembly building, erected in only nine weeks time, will help the Bullard Co. double last year's output during 1941*

Bullard Co. Builds and Puts into Operation $4,000,000 Assembly Plant with Record Speed

BRIDGEPORT—The record-breaking speed with which the Bullard Co. has expanded its productive facilities for national defense was signalized on Monday, July 28, by a housewarming marking official completion and operation of its new $4,000,000 assembly building. After a luncheon in the company's cafeteria, a general inspection tour of the plant was made. Later in the afternoon a New England clambake was held on the estate of E. P. Bullard, president of the company. In attendance were representatives of the Army and Navy, OPM, directors and members of the defense committee of the National Machine Tool Builders Association, members of the State educational department, and leaders in the governmental, civic and business life of Bridgeport and Fairfield.

The new assembly building was erected with unusual speed by the Turner Construction Co., New York. Steel was delivered to the site April 28. Bullard officials took possession of the plant July 4, and operating and manufacturing equipment was installed during the next ten days. By July 15 finished machine tools were being shipped to defense plants. Measuring 540x180 ft., the new plant occupies over three acres of production space. It is the largest of six additions to the Bullard factories built since May of last year. Three 60-ft. craneways have been installed as part of a specially planned assembly line which has been largely responsible for the effective speed-up of work. Exterior walls of the new building are of protected metal and glass, the sides facing the sun using a special type of heat-absorbing, glare-eliminating glass.

Shipments by the Bullard Co. during 1940 were double those of the previous year. It is estimated that 1941 production will be twice that of 1940. The number of employees has increased from 1,600 last year to over 3,200. The Bullard apprenticeship system operated in conjunction with the State trade school in Bridgeport has played a major part in the training of necessary employees. E. P. Bullard has been president of the company since 1906, succeeding in that year his father, E. P. Bullard, Sr., founder of the company, upon the latter's death. E. C. Bullard is vice-president and general manager.

South American Machine Tools to Be Sold in U. S.

CLEVELAND—Lempco Products, Inc., has made arrangements to serve as exclusive American and British distributors for five machine tool manufacturing companies in Argentina and Brazil. The initial allotment on an order for 47 machines has been received, the shipment including shapers, drill presses, punch presses, die filing machines and hand screw machines. Later in the year deliveries are expected of large turret lathes, planers, heavy-duty drill presses and milling machines. Two more carloads are slated to leave Argentina soon.

James F. Strnad, president of Lempco, disclosed that three of the companies are in Buenos Aires and two in Sao Paulo. He found that these builders had a surplus of machines and were eager to enter the American market. He said that spare parts for the new machines will be imported in order to service the tools and that eventually Lempco might import key machine parts and assemble complete units here. Mr. Strnad is a native American of Czecho-Slovakian descent who founded his business in Cleveland 22 years ago and now has 275 employees. John Blazek is vice-president and general factory manager.

Canada's War Production Rises at Rapid Pace

MONTREAL—Canada is pretty well out of the woods so far as machine tools go, thanks to heavy purchases from the United States. Imports from the U. S. in July, August and September will reach new record levels, says Thomas Arnold, machine tool controller.

Canada's aircraft production during the three months ended June 30 was 25 per cent ahead of that in the first quarter and was ten times greater than the 1939 output. First half assemblies were larger than in all of 1940. At the moment, output is declining because of the switch from fighters to bomber construction. But production will expand steadily again as the year progresses. In the second quarter of this year over 200 planes were received from the United States and nearly 300 from Britain for the expanded Commonwealth Air Training Plan. Employees of Canadian Car & Foundry have delivered three Hurricane fighters to Wings For Britain, which they paid for themselves, working on the planes on their own time.

Production of passenger automobiles is being cut down progressively in line with similar policies in the United States. On April 1 a 20 per cent reduction in new car production was ordered for the balance of the year. Last December the import of automobiles into Canada was ordered cut 20 per cent from the previous year's level, partly to conserve U. S. exchange. Another order for curtailment of motor car output is imminent. The total reduction in the 1941-1942 season may run 50 per cent.

Canadian National Railways is buying this month some $20,000,000 of new rolling stock from Canadian railway equipment companies.

LITTLE LABOR TROUBLE

OTTAWA — Labor troubles in Canada have been confined lately to a few trouble spots of long standing, notably the coal mines of Nova Scotia, where production slow-down tactics have been used, and the Hamilton, Ont., plant of the National Steel Car Corp., which was taken over by the government several months ago. The government report for June reveals only 29 strikes and lockouts, involving 7,320 men and lost time of 38,143 working days. Chief disputes in June were in the hosiery industry, plus the short-lived strike at the Canadian General Electric plant in Toronto, which ended when the government interned the strike leaders and ordered fines for any workers failing to return to work immediately.

Unions Dig in as Defense Orders Give Chance to Gain Unprecedented Demands

NEW YORK—As C.I.O.'s sprawling, powerful United Automobile Workers Union wound up its convention in Buffalo this week, the realization that a subtle change in labor relations had taken place in the last three months was effectively driven home. The U.A.W., with almost half a million members working under contracts with automobile, aircraft and allied industry manufacturers, is a symbol of that change. Up until a few months ago U.A.W., like the rest of the industrial union movement, was concerned only with wages, hours and recognition. Now, the objective of the new unionism is to establish itself beyond challenge. That means aiming for such "union security" devices as compulsory maintainence of membership, closed shop and check-off of union dues.

Unquestionably the exigencies of defense production provided the climate in which that change took place. With production needs paramount, a strike which formerly resolved itself into a test of economic strength between an employer and a union became a national danger. Employers made unprecedented concessions rather than face the possibility that they would be held up to public view as men who put selfish interests above patriotism. Government agencies, particularly the newly created National Defense Mediation Board, assumed that employers could be made more pliable than labor and recommended settlement of labor disputes which gave unionism an improved status.

Although it began before the dramatic North American Aviation Co. strike early in June, that settlement set a seal of certainty on what role the government was going to play in promoting unionism. Even while soldiers were still occupying the North American plant, and some sections of business were openly rejoicing because Washington had finally "taken a firm stand against irresponsible unionists," the strikers were being handed—at the behest of the Mediation Board—the most favorable union contract in the aircraft industry. In addition to providing a thumping wage increase, it carried a maintainence of membership proviso which said that any North American employee who had ever joined, or would ever join, the union must continue or lost his job.

After that, in swift succession, Henry Ford presented the C.I.O. with a union shop, check-off contract, Youngstown Sheet and Tube and Republic Steel agreed to come to terms with the Steel Workers Organizing Committee, Bethlehem Steel Shipyards on the West Coast agreed—again at the Mediation Board's request—to sign a closed shop contract with A.F.L. metal trades unions, Ernest T. Weir's Great Lakes Steel signed an S.W.O.C. agreement, and Briggs Body gave the U.A.W. substantially the same arrangement that the union got from Ford.

With such outspoken champions of the open-shop as Ford, Grace, Weir, and Girdler either submitting to the closed shop or giving outside unionism a recognized foothold in their companies, a major change had been accomplished. It came about because, as another important employer put it recently, "You have a 50-50 chance of licking a union, but when you've got the unions and the government teamed up against you, you just give up."

How much the unions have come now to rely on government "cooperation" is illustrated by the recent strike at the Air Associates Inc. plant in Bendix, N. J. When the strikers could not force the company to submit to their demands, they wired Mr. Roosevelt and the OPM asking that the government "take over" the plant. They seemed certain that Army occupation would, like in the North American affair, guarantee a favorable outcome.

Thus, current union ambitions aim to take unionism a big step above the position they seemed satisfied with before. With wages at the highest level ever reached, labor organizations are now concentrating their energies on "sewing up" their industries with closed shop and check-off contracts.

G.E. Factory Nears Completion For Supercharger Manufacture

SCHENECTADY, N. Y.—A one-story windowless "blackout" factory of 225,000 sq.ft. to be used by General Electric for the manufacture of superchargers for military airplanes has been erected on the marshes near Lynn, Mass. The manufacturing area will be lighted by flourescent lamps which will double the average light in present-day factories. Air conditioning will keep the temperature at least twelve degrees cooler on the hottest summer days. The building is completely blacked out and is invisible at night from the air. The roof treatment lends itself easily to camouflage.

N.A.M. Survey Shows Labor Shortage, Relief Roll Cut

NEW YORK—The mid-year picture of employment based on a survey in 21 key cities by the National Association of Manufacturers showed relief rolls cut in half, nearly to the normal number of unemployables. Skilled labor shortage is so acute that in some instances industry is training women and physically handicapped men.

Reports on unemployment in the cities canvassed confirm the findings of the National Industrial Conference Board which estimated the number of unemployed at 3,962,000 as of June 1, little more than the total in the lush days of 1929.

Exports of Machinery During May, 1941

	May 1941	April 1941	May 1940
Electrical machinery and apparatus	$12,276,019	$11,558,112	$9,636,564
Power-generating machinery, except electric and automotive	4,295,292	3,173,673	1,633,174
Construction and conveying machinery	3,358,836	2,944,385	2,922,010
Mining well and pumping machinery	3,249,537	3,941,353	4,421,827
Power-driven metal-working machinery	15,611,065	20,032,856	19,142,225
Other metal-working machinery	1,531,070	1,906,059	681,920

Metal-Working Machinery

Engine lathes	529,129	1,200,744	1,393,405
Turret lathes	1,064,629	2,534,895	1,675,448
Other lathes	820,541	2,982	969,472
Vertical boring mills and chucking machines	581,371	639,585	674,470
Thread-cutting and automatic screw machines	1,794,372	1,426,085	1,729,593
Knee and column type milling machines	1,218,886	1,998,082	825,544
Other milling machines	1,731,463	1,918,919	1,490,154
Gear-cutting machines	539,756	422,501	722,991
Vertical drilling machines	247,143	495,652	309,606
Radial drilling machines	109,925	219,349	346,602
Other drilling machines	319,368	588,639	276,262
Planers and shapers	478,694	769,666	377,823
Surface grinding machines	599,475	452,148	440,416
External cylindrical grinding machines	359,908	769,511	755,987
Internal grinding machines	150,928	402,050	898,595
Tool grinding, cutter grinding, and universal grinding machines	482,383	604,957	431,064
Other metal-grinding machines and parts	468,545	476,284	795,080
Sheet and plate metal-working machines and parts	1,065,306	1,515,120	756,762
Forging machinery and parts	825,570	1,446,715	1,261,457
Rolling-mill machinery and parts	227,136	345,825	914,454
Molding machines	21,991	19,099	37,245
Other foundry equipment and parts	252,299	259,626	254,575
Other power-driven metal-working machinery and parts	1,710,288	1,513,889	1,778,804
Pneumatic portable tools	146,860	168,041	207,765
Other portable and hand or foot-operated metal-working machines and parts	201,967	226,620	160,343
Chucks for machine tools	83,601	63,028	40,668
Milling cutters, machine-operated threading dies and taps, and similar machine-operated metal cutting tools	681,072	726,552	96,420
Other metal-working machine tools and parts	417,570	721,818	176,724

OPM Starts Campaign to Salvage Alloy Content of Steels by Segregating Scrap

WASHINGTON—OPM and the steel industry have combined in a campaign to conserve more completely the alloy content of alloy iron and steel scrap. In many manufacturing plants it is estimated that 20 to 40 per cent of the alloy steel is lost as scrap during conversion into finished products, and sometimes the loss runs as high as 70 to 80 per cent. Much of the alloy content of such scrap is lost for alloying use when it becomes mixed with other steel or metal scrap. This is especially true of machine turnings or chips, forging flashings and, to a less extent, of heavier melting scrap, such as bar ends, large punchings and rejects. A similar situation exists in plants using alloy iron.

Under the circumstances OPM is requesting all users of alloy iron and steel to insure proper segregation and identification of scrap and its return in acceptable and usable form free from contamination, either direct to the suppliers or to scrap dealers. So far as steel scrap is concerned, it is being divided into a number of classifications. Nine groups are suggested for low alloy steels:

Group 1—2500 series (4.75-5.25 per cent nickel)
(If available only in small quantity, mix with Group 1a)

1a—2300 series (3.25-3.75 per cent nickel)
(If available only in small quantity, mix with Group 1)

Group 2—3300 series (3.25-3.75 per cent nickel, 1.25-1.75 per cent chromium)
3400 series (2.75-3.25 per cent nickel, 0.60-0.95 per cent chromium)
(If available only in small quantities, mix with Group 4)

2a—3200 series (1.50-2.00 per cent nickel, 0.90-1.25 per cent chromium)
3100 series (1.00-1.50 per cent nickel, 0.45-0.75 per cent chromium)
(These series should be segregated individually if available in quantity, otherwise the group is intended to apply in general to low nickel content—2 per cent and under—steel scrap)

Group 3—4800 series (3.25-3.75 per cent nickel, 9.20-0.30 per cent molybdenum)
(If available only in small quantity, mix with Group 3a or Group 2 or Group 4, according to which group of scrap predominates, and in the order of preference stated)

3a—4600 series (1.65-2.00 nickel, 0.20-0.30 per cent molybdenum)
(If available only in small quantity, mix with Group 3 or Group 4)

Group 4—4300 series (1.65-2.00 per cent nickel, —per cent chromium, 0.20-0.30 per cent molybdenum)
(Other combinations of nickel, chromium, molybdenum or nickel, chromium, molybdenum, vanadium are included in this group)

Group 5—4100 series (0.45-1.10 per cent chromium, 0.15-.30 per cent molybdenum)

Group 6—6100 series (0.70-1.10 per cent chromium, 0.10 per cent minimum vanadium)

Group 7—5100 series (0.50-1.20 per cent chromium)

7a—5200 series (.45-1.65 per cent chromium, .90-1.15 per cent carbon)

Group 8—4000 series and other carbon-molybdenum steels (0.15 per cent minimum molybdenum)

Group 9—Chromium molybdenum oil refinery scrap

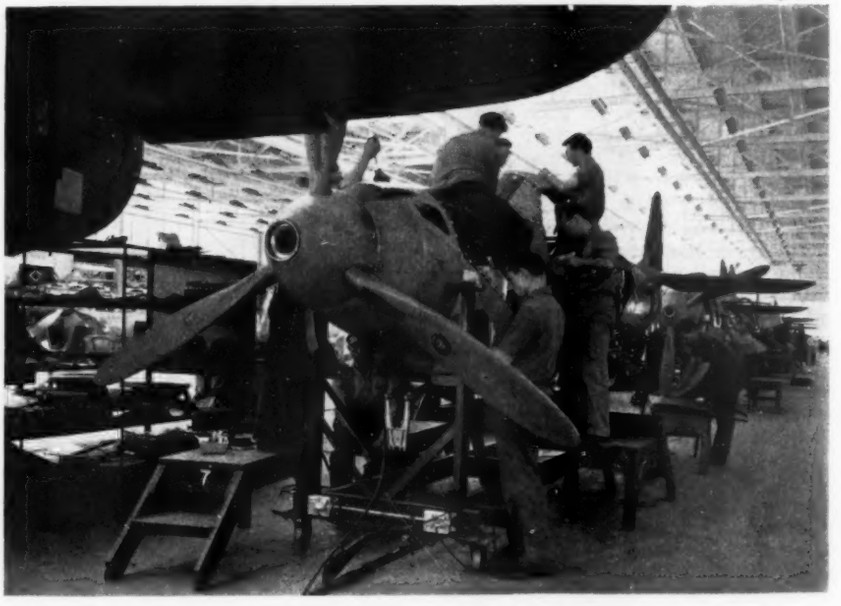
In the stainless steel grouping are two main classifications, chrome-nickel base alloys and chromium base alloys. The chrome-nickel base alloys should be graded according to their content of nickel, carbon, stabilizing elements and elements added for machinability. The nickel content is divided into three groups: over 1 per cent to 7 per cent; over 7 per cent to 10 per cent; and over 10 per cent to 22 per cent. Carbon content is divided into steel with less than 0.08 per cent maximum and steel with over 0.08 per cent. Each alloy such as molybdenum, titanium and columbium should be kept separate. In the elements added for machinability, two gradings are suggested: alloy steel with a maximum of .035 per cent of sulphur, phosphorus and selenium each, and that containing more than that amount. Each element should be kept separate. In the grouping of chromium base alloys, chromium is divided into that from 12 to 14 per cent, that over 14 to 18 per cent, and that over 18 per cent. Carbon content is divided into that with 0.15 per cent as a maximum, and that containing over 0.15 per cent. The qualifications for the elements added for machinability are the same as those for chrome-nickel base alloys.

Alloy scrap of special chemistry not covered by the above standardized grades should be segregated and returned to the maker, or arrangement for disposal should be made on the maker's advice. OPM points out that the proper segregation and identification of the various grades of heavy melting scrap is largely a matter of supervision and provision for storage space, but light scrap, such as turnings, involves baling as well as washing if the cutting oil is to be recovered.

Many plants should find it feasible to install salvaging equipment to carry out these operations, says OPM. In any event, every plant is asked to consult with its steel supplier to assure the most appropriate measures for salvaging all alloy scrap in a condition to permit use of its alloy content.

RELEASE OF SKILLED WORKERS

WASHINGTON—If a manufacturer urgently needs the services of a skilled former employee now in military service, he must make application to the office of Under Secretary of War Robert P. Patterson. He must make a separate request for each employee and must agree under oath to reemploy the worker immediately. He must prove to the War Department's satisfaction that the soldier is a key man and that a shortage exists in his category. When released, enlisted men and trainees are transferred to the Enlisted Reserve Corps as occupational specialists. They may be recalled to military duty if they leave their defense industry jobs.



Airacobra Assembly—*Airacobras for the U. S. Army Air Corps are now rolling off two conveyorized production lines in the new assembly plant recently completed for Bell Aircraft Corp. at Niagara Falls, N. Y. Two more lines, already installed, will soon begin to move. Provision has been made to increase the number of lines to six. The new plant was designed and built by the Austin Co.*

INSIDE DETROIT

Flexible curtailment plan may be adopted for autos and other consumer goods. Manufacturers now looking for more work while defense orders go begging. Better system of contracting needed

BY RUPERT LE GRAND, DETROIT EDITOR

DETROIT — Last week's important meeting of the OPM and the Auto Defense Industry Advisory Committee is unlikely to establish a curtailment program that will not require constant modification. The entire question of curtailment of autos, refrigerators, washing machines and radios is tied up with two problems facing the government: (1) how best to effect the transition from a peacetime to a wartime economy, and (2) how to get defense contracts into the hands of industry at an accelerated pace. The arguments over the best means of accomplishing these two objectives have raged loud and long, shifts in policy have occurred, and they are likely to happen again.

Many months ago OPM decreed an initial 20 per cent cut in production for the 1942 season. Upon closer view, particularly of the mounting scarcity of materials for non-defense purposes, it is understood that Mr. Knudsen's office favored flexible curtailment. Leon Henderson, on the other hand fell into the old trap of talking percentages. Within the auto industry itself there is strong opposition to the flexible curtailment plan, upon the basis that car and defense production must be forecast on a definite program. It is argued that with mounting difficulties in obtaining materials, more time is now needed to plan production schedules. Important interests object strongly to Mr. Knudsen's short-time schedule —a 20 per cent reduction for August, September and October, with future cuts made in relation to materials available for non-defense purposes.

The extent of the emergency is immeasurable, which means that it is impossible to establish long-period production quotas for non-defense goods regardless of how well it can be demonstrated that their continued manufacture is essential to the national wellbeing. There is a school of thought in Washington which holds that autos, refrigerators, washing machines and radios should immediately be curtailed 100 per cent and an all-out effort made to put the country on a war basis by January, upon the theory that "Hitler won't wait." Informed observers believe that the resultant unemployment might reach 500,000 people in the industries mentioned, half of them in autos alone. Regardless of the widespread hardships created, it is believed by adherents of this policy that defense would get on a firm footing months sooner than by cutting down non-defense manufacture gradually as defense is able to take up the slack in employment. The opponents of this plan doubt that much would actually be gained by this process, since in the case of General Motors, for example, 90 per cent of its $1,200,000,000 worth of war contracts is outside the normal of production of the industry.

So unless some compelling circumstance arises to force an all-out war economy, it is likely that a compromise will be reached between the "flexible" curtailment idea and that of a definite plan. The government must have the last say, and those who oppose short-time planning must inevitably give ground, regardless of the inconveniences to themselves.

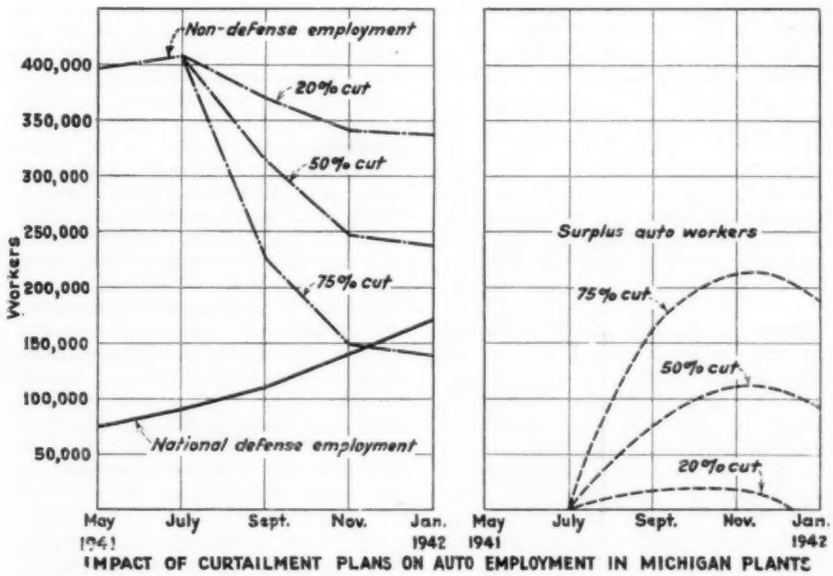
Placement of Orders Speeded

Large automotive manufacturers have been actively hounding Washington for more defense work. A much better system of letting contracts and sub-contracts is needed and OPM is now working on a plan to speed up the process of getting defense work more rapidly into the hands of industry. Detailed lists of projects are being obtained by OPM from the armed services. These new jobs will probably be let by the competitive bidding and the negotiated contract systems instead of allocation as planned under the M-day program. It has been demonstrated in Washington that the services have been unable to keep abreast of the defense work now already underway in large auto plants, that facilities which the Army had planned to use on M-day are already engaged on other and more pressing defense projects. To revive the allocation plan in event of war is deemed suicide in Detroit because of the widespread confusion it would create.

One of the main results of last week's joint meeting of OPM and OPACS with the auto industry's representatives was a request for additional information on the timing of transfer of auto workers to defense jobs. Labor and Michigan authorities had made it clear that an immediate

SHELL CASES BY FISHER?

DETROIT—Auto curtailment may conceivably fall hardest upon body plants. Fisher Body, while actively engaged in bomber-parts production, manufacture of Navy material and building of planes under sub-contract, is reported considering plans to produce cartridge cases in large volume and perhaps projectiles for anti-aircraft guns. Fisher's huge capacity will apparently be drawn into the government's procurement program for many million small projectiles per day, but the company has not yet received a letter of intent.



IMPACT OF CURTAILMENT PLANS ON AUTO EMPLOYMENT IN MICHIGAN PLANTS

Curtailment vs. Employment—*Trends forecast by this chart indicate that arbitrary restriction of auto output may throw men out of work faster than the defense industries can absorb them*

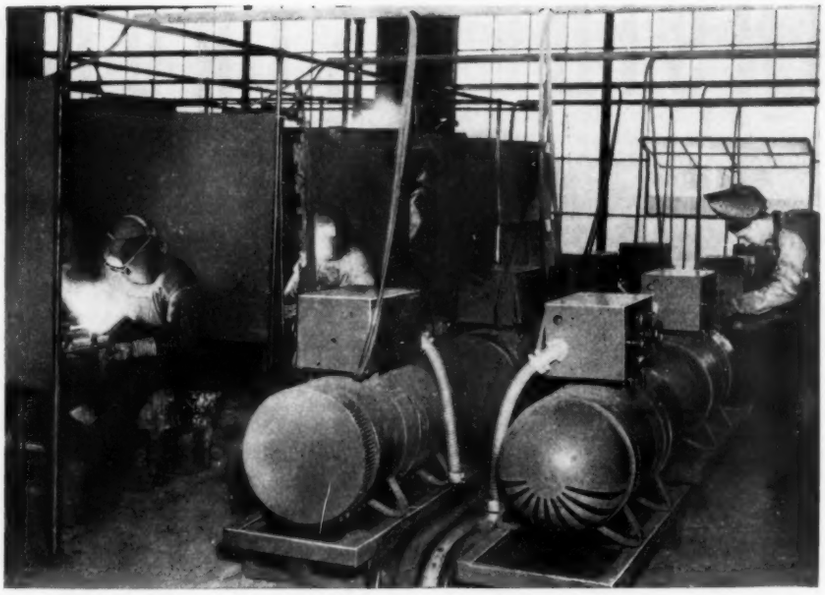
and drastic curtailment of output, such as 50 per cent, will not accomplish the rapid siphoning of auto labor into defense work, but instead will create a severe unemployment problem.

Authentic data on the subject reveal that a 20 per cent curtailment will create a negligible amount of unemployment during the fall months, and that defense needs will actually create an excess number of jobs by January. But with a 50 per cent slash in output in September, at least 42 per cent of auto workers, or approximately 170,000 persons in Michigan alone, would lose their jobs by January. Offsetting these job losses would be placements of approximately 90,000 workers in automotive defense jobs and a much smaller number in defense work handled by non-automotive companies.

As a net result, the defense efforts of the automotive and non-automotive industries of the state would be unable to absorb some 75,000 displaced auto workers by the year end. Further, it is probable that at least 15,000 of the displaced auto workers could not get jobs anyway because of location, different job experience, and through hiring of other workers, especially those being trained under the Training Within Industry program.

Shut-Downs for Model Changes

The bulk of the automotive industry is going through the birth pains of the new-model changeover, although Hudson is now in production on 1942 cars. All General Motors divisions, with the exception of Chevrolet, were expected to go down at the end of July, with the latter continuing perhaps a week at Flint. Ford plans to continue assemblies at a diminishing rate until approximately August 10, because of prior difficulties in getting a sufficient number of engines. All Chrysler divisions were closed last week, having been preceded by Plymouth. Passenger-car production until November 1 may be held to the original curtailment plan, that is, averaging 80 per cent of output in comparable months a year ago, but truck production will be exempted from curtailment. Parts manufacturers were working approximately to capacity through July, but a sharp pinch is expected to set in within a week or two unless restrictions upon materials are lifted. New havoc is expected by orders restraining use of brass and cutting tools for non-defense purposes. Parts makers affected by these and similar rulings are expected to state their case through customers and representatives upon the Auto Advisory Committee. Manufacturers of original-equipment parts are expected to turn to the replacement-parts field, because Washington will undoubtedly lay emphasis upon keeping present rolling stock of 31,000,000 vehicles in operation.



Welding Defense—*The demand for trained operators on welded products for defense has kept the Lincoln School of Arc Welding, conducted by the Lincoln Electric Co., busy 24 hours a day. With four classes running simultaneously approximately 240 men are graduated each month*

OPM Looks to Railroads as Labor Source for The Aviation and Shipbuilding Industries

WASHINGTON — Estimates of labor requirements in the aircraft and shipbuilding industries are climbing steeply as programs expand. The Labor Department, which did pretty well last fall at estimating requirements to date, says that the airplane industry, including sub-contractors, will be employing 580,000 men by November. This compares with about 290,000 last March and something like 460,000 now. Moreover, rough estimates of the potentialities of the new bomber program suggest an employment of 800,000 by next Spring and more than a million by the end of 1942.

Splitting up of jobs and introduction of mass production methods have substantially lowered the number of skilled men required, but this still represents 30-40 percent of the demand. And these are the hardest men to find.

Hillman's division of OPM, which has the job of finding labor for defense plants, is turning to the railroad field to help fill the skilled portion of the demand. It is recognized that the railroads themselves are going to be increasingly overburdened with work. A similar effort to get aircraft workers from the rails a year ago flopped dismally because the men preferred to stick with the lines.

It is felt that the rigid seniority rules of the railroad brotherhoods have created a peculiar situation on the rails. Thousands of men rated as helpers or semi-skilled have actually had years of experience and are ripe for up-grading to better jobs. The plan, therefore, is to draw off the skilled men from the top for aircraft plants, and let the rails get along with the rest. It is believed that as many as 80,000 men might be obtained in this way.

First announcement of the plan brought a howl of protest from rail management. Hillman, however, in recent months has shown himself not averse to applying the heat on occasion, and it is now believed that the railroads, willy nilly, will cooperate. Conferences of OPM, the managements, and the brotherhoods are now being held to thrash out the knotty problems involved. Most serious, probably, is that some way must be found by which the men transferred can maintain their seniority.

To avoid unnecessary importation of "out-of-town" labor and resulting housing difficulties, Mr. Hillman urges airplane manufacturers to employ qualified women. His suggestion is made in a letter to 200 airplane companies. If qualified women cannot be found for jobs which women could do, the State Employment Service will train them. Hillman suggests employment of women in other defense production such as radio, electrical goods, small parts. Employment and training of women will not be allowed to lower wages and working conditions or to increase hours.

WATCHING WASHINGTON

Machine tools released to Russia. Soviet mechanized equipment surprises experts. Congress tones down property "draft" bill. Priority given to civilian airplanes, threatened with extinction

By BLAINE STUBBLEFIELD

WASHINGTON—The Russians want machine tools from this country. What other equipment they want from us will not be known till the Soviet Embassy and its military aides here complete a list they are working on. This list may not be made public. Meanwhile conjecture is useless.

The $1,700,000 worth of machine tools sold to the Soviet but held up on our west coast months ago has been released and is on its way. The shipments were stopped because of the Soviet attack on Finland. AMERICAN MACHINIST learned that the Russians were so anxious to get the tools that they have had ships waiting on our West coast all this time.

Whether Russia falls back before the Nazis or not, their resistance has already upset much expert dope. One specialist on Russia, in this government, says that even the G-2 sleuths of our Army have been badly wrong in their opinion that the Comrades couldn't turn out quality tanks, airplanes and other munitions.

There are two channels open for dealing with Russia. One is lease-lend. The Administration has announced publicly that it will aid anybody who fights Germany, and specifically Russia. But Russia, which apparently has not asked for such assistance, and which has plenty of money in the New York banks, has not been declared eligible for lease-lend goods as yet.

The other channel is straight-out trade on a cash basis. Russia has a number of minerals, especially manganese and chrome, which we would like to buy with cash, which Russia could use to buy munitions from us.

The big trouble with both schemes is the long haul overland to the port of Vladivostok, plus the possibility of belligerent action by Japan in the Pacific against Russia, the United States or Britain, or all three.

Property "Draft" Dented

Congress is taking a lot of thunder out of the Administration's "draft property" bill. The Senate passed it, authorizing the President to take not "property of any kind" but only military equipment and supplies, and he must return it to the owners, if they want it, not later than December 31, 1943. He must report to Congress on seized property every six months. He can take property only when it is needed for defense, and only after all other means of obtaining it on fair and reasonable terms have been exhausted. All properties requisitioned must be paid for, and of course owners will pay when they take them back.

Now the measure is in the House Military Affairs Committee, which will take a long look and make many changes before sending it up for House vote. Congress is de-horning this bill in a determined and confident manner, apparently intent upon forestalling any step toward socialization of industry. The purpose of the bill is to enable the President to requisition tools, equipment, land, etc., which he may find could be put to better defense use. This measure has no relation to the seizure of struck plants.

Civilian Planes Get Reprieve

One civilian industry that seemed inevitably headed for the junkpile a month or so ago has been granted a reprieve with award of an A-10 priority rating to the light plane industry, builders of the 45-65-hp. flivvers you see on every pasture with a windsock. First relief came about a month ago, when OPM began granting limited amounts of aluminum to a half dozen builders of planes for the Civilian Pilot Training program. The new move indicates an intention to supply aluminum, and makes it possible to get other items such as rubber, alloy steel, plastics and the like. The A-10 rating goes to about 26 builders of planes, engines and radios. It covers not only CPTP trainers but planes sold for a wide variety of purposes—nearly everything except joyriding. And the joyriders get their innings too. Even if they don't want to join a civil defense unit—which would permit them to buy a plane—there will be lots of slightly used planes available, since plane-buyers under the rating plan need only certify as to the use to which the plane will be put for the first three months. Light plane makers expect, under the new plan, to build 6,000-7,000 planes a year—slightly more than last year.

Not so fortunate was the radio industry. OPM has decided to grant it only enough aluminum for manufacture of replacement parts and a limited and constantly decreasing, volume of new set production. For July, the industry was alloted 70,000 lbs. of secondary aluminum and 40,000 lbs. of virgin. This compares with a monthly consumption last year of 350,000 lbs. of virgin. However, the cut in output will not be quite as sharp as this suggests, since extensive substitutions for aluminum have already been effected.

The purpose of allowing any production at all of new sets is to tide the industry over until defense work can be allocated. There will be plenty of this, since the pending supplemental defense appropriation includes nearly a half billion dollars for military radios.

CONCRETE SHIPS AGAIN?

Reliable information indicates that the Navy is building an experimental concrete oil storage tank which can be towed to a desired location. If it is successful, presumably a number of the tanks will be built.

This brings up again the question of concrete ships. American Machinist finds that a number of concrete vessels, built for the Army during the world war, are still operating on inland waters—12 cargo vessels, three oil tankers, six oil barges, and others. The contractor who built 43 of these units says he could build vessels up to 5,000 tons. In his experience concrete ships can be built in one third of the time required for steel construction and at one third less cost.

Navy Wants Planes First

First open rebellion in the armed forces against shipment of weapons abroad came from Admiral Towers, head of the Navy's Bureau of Aeronautics. The question arose over priorities, on which the Navy is accustomed to having an advantage. Naval aircraft, which generally stay here, have had an A-1-b rating mostly, as compared to the A-1-d rating of Army aircraft—which largely go abroad. When the bomber program, geared to British needs, was granted an A-1-b rating, the Navy lost its advantage, in tool procurement particularly. Admiral Towers says that naval plane deliveries are running about 20 percent behind schedule. The first four months of the year, deliveries to the Navy totalled 996, of which 600 were combat types. He sees no hope of catching up unless the priority situation is corrected.

U. S. Government Contracts Awarded to Metal-Working Firms

(Does not include contracts under $350,000)

Source	Agency	Commodity	Amount
Pratt & Whitney Aircraft, East Hartford, Conn.	War	Engines and parts	$1,817,717
Neptune Meter Co., Long Island City, N. Y.	"	Fuze	380,000
Murray Mfg. Corp., Brooklyn, N. Y.	"	Shell*	1,792,000
John Dunlap Co., Carnegie, Pa.	"	Cartridge cases*	970,000
Servel, Inc., Evansville, Ind.	"	Cartridge cases*	797,297
The Gabriel Co., Cleveland, Ohio	"	Shell*	610,000
General Motors Corp., Anderson, Ind.	"	Cartridge cases*	601,000
Auto Specialties Mfg. Co., St. Joseph, Mich.	"	Shell*	595,000
Pittsburgh Steel Foundry, Glassport, Pa.	"	Gun carriages*	573,731
General Steel Castings Corp., Eddystone, Pa.	"	Gun carriages*	396,035
Ford Motor Co., Dearborn, Mich.	"	Trucks	3,389,346
Fargo Motor Corp., Detroit, Mich.	"	Trucks	2,260,940
Bethlehem Steel Co., Bethlehem, Pa.	"	Projectiles	15,442,660
Standard Tube Co., Detroit, Mich.	"	Forgings	1,098,000
International Harvester Co., Chicago, Ill.	"	Trucks	984,848
Continental Motors Corp., Muskegon, Mich.	"	Parts for tanks	249,565
Guiberson Diesel Engine Co., Chicago, Ill.	"	Engines and tank parts	4,551,650
Long Reach Machine Works, Houston, Texas	"	Lathes	420,480
Aviation Mfg. Corp., Williamsport, Pa.	"	Aeronautical engines	17,993,884
Clark Equipment Co., Battle Creek, Mich.	"	Tractors and parts	2,229,440
Jack and Heintz, Inc., Cleveland, Ohio.	"	Starter assemblies	1,925,000
General Motors Corp., Dayton, Ohio	"	Boosters and shell	2,214,260
National Stamping Co., Detroit, Mich	"	Metallic belt links	1,628,625
Edgemoor Iron Works, Inc., Edgemoor, Del.	"	Shell	7,031,000
Scullin Steel Co., St. Louis, Mo	"	Bomb material	1,485,000
Republic Steel Corp., Cleveland, Ohio.	"	Armor plate	5,423,000
Southern States Equipment Corp., Birmingham	"	Boosters	561,370
Faultless Caster Corp., Evansville, Ind.	"	Fuse	552,500
Grapho Products, Inc., Indianapolis, Ind.	"	Shell	947,200
Indianapolis Drop Forging Co., Indianapolis, Ind.	"	Shot	1,800,500
Schwitzer-Cummins Co., Indianapolis, Ind.	"	Cartridge cases	526,320
Servel, Inc., Evansville, Ind	"	Cartridge cases	561,600
Electric Vacuum Cleaner Co., Cleveland, Ohio	"	Fuze	1,438,500
General Industries, Inc., Elyria, Ohio	"	Fuze	925,000
Globe Machine & Stamping Co., Cleveland, Ohio.	"	Cartridge cases	1,137,500
Hoover Co., North Canton, Ohio	"	Fuze	1,086,400
Mullins Mfg. Co., Warren, Ohio	"	Cartridge cases	2,311,944
Chase Brass & Copper Co., Waterbury, Conn	"	Cartridge cases	1,484,625
Sargent & Co., New Haven, Conn	"	Fuze	2,319,660
Scovill Mfg. Co., Waterbury, Conn.	"	Cartridge cases & boosters	7,508,465
E. G. Budd Mfg. Co., Philadelphia, Pa.	"	Shell	1,507,872
Kramer Trenton Co., Trenton, N. J	"	Cartridge cases	595,720
Aircraft, Inc., Santa Monica, Calif.	"	Shell	730,800
Norris Stamping & Mfg. Co., Los Angeles, Calif.	"	Cartridge cases	1,935,200
Kilgore Mfg. Co., Tipp City, Ohio	"	Aircraft signals	1,422,824
Byron Jackson Co., Los Angeles, Calif	"	Recoil mechanisms	1,395,000
Gilbert & Barker Mfg. Co., Springfield, Mass.	"	Water jackets	523,792
Chicago Flexible Shaft Co., Chicago, Ill	"	Fuse	573,845
Hannifin Mfg. Co., Chicago, Ill	"	Recoil mechanisms, equilibrators and tools	2,005,000
Fort Pitt Bedding Co., Pittsburgh, Pa	"	Metallic belt links	720,000
Curtiss-Wright Corp., Caldwell, N. J.	"	Propellers and governors	1,194,821
Chandler-Evans Corp., South Meriden, Conn	"	Fuel pumps	921,500
Kelsey-Hayes Wheel Co., Detroit, Mich.	"	Oxygen cylinders	531,319
Republic Aviation Corp., Farmingdale, N. Y.	"	Maintenance parts	781,946
Lord Mfg. Co., Erie, Pa	"	Maintenance parts	695,599
Wright Aeronautical Corp., Paterson, N. J	"	Parts and tools	5,176,742
Sperry Gyroscope Co., Inc., Brooklyn, N. Y.	"	Maintenance parts	1,238,196
North American Aviation, Inglewood, Calif.	"	Maintenance parts	1,360,505
Consolidated Aircraft Corp., San Diego	"	Maintenance parts	568,087
Vultee Aircraft Inc., Vultee Field, Calif	"	Maintenance parts	1,374,115
Independent Engineering Co., O'Fallon, Ill	"	Portable generators	618,000
Boeing Aircraft Co., Seattle, Wash	"	Maintenance parts	2,872,680
The Glenn L. Martin Co., Baltimore, Md	"	Airplanes and parts	158,389,728
Federal Motor Truck Co., Detroit, Mich	"	Trucks	824,670
Consolidated Aircraft Corp., San Diego, Calif.	"	Spare parts	4,003,941
Chandler-Hill Corp., Detroit, Mich.	"	Fuel pumps	535,750
General Motors Corp., Indianapolis, Ind.	"	Engines and parts	734,717
Standard Steel Works, North Kansas City	"	Trailers	965,448
Douglas Aircraft Co., Inc., Santa Monica, Calif.	"	Spare parts	1,524,863
Harrisburg Steel Corp., Harrisburg, Pa.	"	Gas cylinders	946,500
Thompson Products, Inc., Cleveland, Ohio	"	Fuel pumps	861,000
Rolls-Royce, Inc., Detroit, Mich	"	Bearings	772,288
Lockheed Aircraft Corp., Burbank, Calif.	"	Spare parts	694,478
Curtiss-Wright Corp., Robertson, Mo.	"	Maintenance parts	390,201
Bendix Aviation Corp., Bendix, N. J.	"	Assemblies	1,036,471
Jackes-Evans Mfg. Co., St. Louis, Mo	"	Machine gun belt links	784,800
Plomb Tool Co., Los Angeles, Calif.	"	Socket wrenches	607,897
Bendix Aviation Corp., Elmira, N. Y.	"	Shell	405,000
Williamette Hyster Co., Peoria, Ill	Treasury	Cranemobiles	1,093,750
Mercer Engineering Works, Inc., Allwood, N. J.	"	Cranes	1,423,775
Stearns-Roger Mfg. Co., Denver, Colo.	War	Turret lathes	830,400
C. H. Cowdrey Machine Works, Fitchburg, Mass.	"	Guns	3,566,800
Prescott Co., Menominee, Mich.	"	Lathes	682,200
Cleveland Tractor Co., Cleveland, Ohio	"	Tractors	1,820,000
General Motors Corp., Detroit, Mich.	"	Trucks	10,434,629
General Motors Corp., Vandalia, Ohio	"	Propeller assemblies	1,481,089
United Aircraft Products, Inc., Los Angeles, Calif.	"	Strut assemblies	595,040
Autocar Co., Ardmore, Pa.	"	Tractor-Trucks	4,997,423
Willys-Overland Motors, Inc., Toledo, Ohio.	"	Shell	480,000
National Pneumatic Co., Rahway, N. J.	"	Boosters	362,880
American Brake Shoe & Foundry Co., Chicago, Ill.	"	Steel forgings	638,600
Hobart Brothers Co., Troy, Ohio	"	Generating units	601,049
McCord Radiator & Mfg. Co., Detroit, Mich.	"	Liners and suspensions	1,821,720
McCord Radiator & Mfg. Co., Detroit, Mich.	"	Helmet assemblies	1,393,650
Globe-Union, Inc., Milwaukee, Wis.	"	Fuze	720,000
Oliver Farm Equipment Co., Chicago, Ill.	"	Shell	648,050
Stewart-Warner Corp., Chicago, Ill.	"	Fuze	2,640,466
Savage Arms Corp., Utica, N. Y.	"	Machine guns	14,334,470
Gisholt Machine Co., Madison, Wis.	"	Equipment for lathes	550,400
A. O. Smith Corp., Milwaukee, Wis.	"	Bomb bodies	3,224,000
General Motors Corp., Dayton, Ohio	"	Landing gear	1,174,250
Sparks-Withington Co., Jackson, Mich.	"	Hoist assemblies	718,648

*Letter of Intent.

Norton Company Announces Retirement Income Plan

WORCESTER, MASS.—The Norton Co. recently announced the adoption of a program that will provide participating employees with a regular monthly income after retirement in addition to benefits received under the Social Security Act. Membership in the Norton plan is voluntary; each participating employee will contribute a small percentage of his monthly earnings. The company will not only match these contributions dollar for dollar but will also contribute for past service. This retirement plan will affect all those of the 6,000 Norton employees between the ages of 30 and 65 who have had five years service with the company. The plan is also being adopted by Norton's two subsidiary corporations: Behr-Manning Corp. of Troy, N. Y., and Norton Pike Co., Littleton, N. H. A retirement annuity contract has been made with John Hancock Mutual Insurance Co.

NAMES in the NEWS

New Sales Manager

J. W. COLGAN

James W. Colgan has been made sales manager of Handy & Harman, 82 Fulton St., New York. He was formerly manager of this company's Canadian subsidiary.

John Eaton, director of the Purchasing Branch, Department of Munitions and Supply, Canada, assumes the post of assistant general purchasing agent of the Canadian Pacific Railway Co. L. L. Price, general purchasing agent of the department, succeeds Mr. Eaton as director of the purchasing branch. W. E. Wilford, the department's purchasing representative at Toronto, has been promoted to the position of general purchasing agent, and R. H. Yarnell, his assistant at Toronto, will now head the Toronto district purchasing office.

General Superintendent

DELBERT B. GEESEMAN

Personnel Director

J. M. MANLEY, JR.

Copperweld Treasurer

THOMAS F. TROXELL

Kaydon Factory Manager

DANIEL M. WATTS

Delbert B. Geeseman has been appointed general superintendent of the Cannonsburg Works, the tin plate manufacturing plant recently acquired by Carnegie-Illinois Steel Corp. from Standard Tin Plate Co. Mr. Geeseman has been Cannonsburg manager for Standard Tin Plate since 1928.

J. M. Manley, Jr., has been appointed personnel director of the Lodge & Shipley Machine Tool Co. For the past ten years Mr. Manley has been secretary of the Industrial Association of Cincinnati, the Cincinnati unit of the National Metal Trades Association and the Associated Foundries of Cincinnati.

Russell G. Davis, for 20 years connected with the Chain Belt Co., Milwaukee, has been named manager of the Commercial Gear plant at Chicago.

W. L. Gourley, president of Lehmann Machine Co., St. Louis, has also been elected as treasurer. L. A. Carter has been elected secretary. Paul Lehmann former vice president and A. H. Lehmann former secretary have resigned.

Otto R. Schoenrock has been named chief engineer for the J. I. Case Co., Racine, Wis. David Pryce Davies, vice-president of the company, has been named consulting engineer for all the Case factories.

Howard T. Walsh has retired as vice president and director of the Sullivan Machinery Co., Michigan City, Ind. Mr. Walsh started as an apprentice in the company's training course and has served continuously for 41 years.

Otto L. Weber has been appointed superintendent of industrial relations at the Edgar Thomson Works, Carnegie-Illinois Steel Corp., at Braddock, Pa. He was formerly at the Gary, Indiana, works of the corporation.

Thomas F. Troxell has been elected treasurer and director of the Copperweld Steel Co. Sidney D. Williams, formerly vice-president in charge of steel sales, has been made executive vice-president in charge of the Warren, Ohio, division. William B. Klee, Jr., assistant secretary, has also been made assistant to the executive vice-president.

Daniel M. Watts, formerly assistant general manager, Bendix Aviation Corp., South Bend, has assumed new duties as factory manager, the Kaydon Engineering Corp., Muskegon, Mich. This concern was recently organized by A. Harold Frauenthal, for a number of years vice-president and general manager of the Bantam Bearings Corp.

A. Elroy Keller has been appointed advertising manager of the Carpenter Steel Co., Reading, Pa.

Eric Nicol has been appointed western chief of the Labor Division's new Labor Supply Branch. Mr. Nicol has been serving as executive assistant to Sidney Hillman.

BUSINESS ITEMS

Chain Belt Co., Milwaukee, has announced that J. Walter Snavely, district manager of the Houston territory for seven years, has returned to the sales department of the Conveying and Engineering Products Division at Milwaukee.

Keystone Carbon Co., St. Marys, Pa., announces the appointment of A. T. Carter, Rochester, N. Y., as representative in upper New York for Keystone motor and generator brushes and resistors. This concern has also appointed the following distributors of their self-lubricating bronze bearings: The Ohio Ball Bearing Co., 6541 Euclid Ave., Cleveland; Indiana Bearings, Inc., 510 N. Capitol St., Indianapolis; and West Virginia Bearings, 8 Virginia St., E. Charlest, W. Va.

Kinney & Askew, Ltd., 415 Lexington Ave., New York, has been organized to specialize in management engineering and industrial public relations. Joseph Kinney, Jr., president of the company has been identified for ten years with the United Engineering & Foundry Co., Pittsburgh, and its affiliate United International of Paris, France. Associated with the company in an advisory capacity is Theodore J. Kauffeld, recently elected vice-president of American Type Founders, Inc. Dean Askew, treasurer of the company, was formerly associated with the General Motors Corp.

McKenna Metals Co., Latrobe, Pa. has appointed Archie A. Morris, Southern California representative. He will have offices at 4905 Santa Fe Ave., Los Angeles.

The Modern Machine Tool & Die Co., Bridgeport, Conn., headed by Walter G. Wessman, has purchased the Voltex Co.'s plant on Reservoir Ave.

Oatis-Booth Machinery Co. has been formed to deal in machinery, tools and compressors. This concern will operate at 325 Richardson Bldg., Toledo, Ohio, and at 434 Merchants Bank Bldg., Indianapolis.

Leon Thorsen, Boston, Mass. has acquired the Union River Machine Co., Ellsworth, Me., and will utilize the plant for shipbuilding purposes. Mr. Thorsen operates the Thorsen Co., Boston.

Vascoloy-Ramet Corp., North Chicago, Ill. has opened a district sales engineering office at 50 Church St., New York. Eugene Roth, eastern district sales manager will be in charge, assisted by Alvan Carver, Harry J. Chase and Standish Rowe.

PLANT EXPANSION

Armstrong-Bray & Co. has completed its new plant and offices at 5366 Northwest Highway, Chicago. This new construction will double the company's capacity on belt hooks and belt lacings.

Allegheny-Ludlum Steel Corp. has increased its productive capacity of high-alloy steels with one new 35-ton electric melting furnace already in operation and another still to be put into service. The increased melting capacity at Breckenridge, Pa., is part of Allegheny-Ludlum's $4,650,000 expansion program which will increase the company's production of special metals by approximately 50,000 tons annually.

Battelle Memorial Institute, Columbus, Ohio, is constructing a $160,000 addition to the process metallurgy laboratory in its fourth major building expansion in recent years. When the new structure is completed, studies of chemical and metallurgical processes on a pilot-plant scale can be conducted.

California Water Heater Co. is building a new one-story factory at a cost of $30,000 at 1801 Pasadena Ave., Los Angeles.

Carboloy Co. Inc., started an addition to its Detroit plant a few weeks ago.

Falk Corp., Milwaukee, has been granted a permit to erect a 400-ft. ramp and viaduct to cost $60,000 to reach new buildings at its plant.

General Electric Co. has greatly expanded production facilities at Lynn, Mass., Erie, Pa. and Schenectady, N. Y. to keep pace with Navy requirements which now include orders for propulsion and auxiliary equipment for battleships, cruisers, destroyers, aircraft carriers, net layers, mine layers, tenders and repair ships.

Geuder, Paeschke & Frey Co., Milwaukee, has been granted a permit to construct a $12,000 factory building.

The Hughes Aircraft Co. has been granted building permit for the construction of two new factory buildings at Jefferson Blvd. and Florence Ave., Los Angeles at a cost of $37,500.

Inland Steel Co. has entered into a tentative contract with the Arthur G. McKee Co., of Cleveland, for the construction of a blast furnace at its Indiana Harbor Works.

Jones & Laughlin Steel Corp., has leased a 3,200-acre tract of land, 65 miles east of Watertown, N. Y., containing deposits of iron ore, in order to increase its pig iron and steel output. Construction of equipment to mine and treat the ore will cost $2,750,000 and require 18 months for completion.

The Hard Chrome Engineering Co. will erect a new factory building at 1717 East Slauson Ave., Los Angeles.

The Jessop Steel Co., Washington, Pa., has begun construction of an 84-in. two-stand plate mill. The mill will be supplemented by the installation of six modern treating furnaces capable of increasing plate production 50 per cent.

Lufkin Machine & Foundry Co. is building an addition to the machine shop at 1750 East Randolph St., Los Angeles at a cost of $12,000.

Norris Stamping & Mfg. Co. is building an addition to its new factory building at 5225 Boyle Ave., Los Angeles at a cost of $25,000.

The Ruthman Machinery Co. has moved into its new plant and office at 1819 Reading Rd., Cincinnati, Ohio. With these new facilities the company can produce about 2,000 gusher coolant pumps a month.

Stokerunit Corp., Milwaukee, will erect a one-story machine shop at a cost of $15,000.

Watertown (Conn.) Mfg. Co. is retooling for the production of gun and rifle stocks to be made of plastic.

Westinghouse Electric & Mfg. Co., will build a $22,000,000 plant to manufacture steam turbines and reduction gears for the United States Maritime Commission under a lease agreement with the Defense Plant Corporation. The plant will adjoin the South Philadelphia Steam Works and employ 1500 workers.

OBITUARIES

Stephen B. Andrews, comptroller, Goulds Pumps, Inc., died July 19 at Seneca Falls, N. Y.

George E. Cullinan, who retired Dec. 31, 1940, as senior vice-president of the Graybar Electric Co., died on July 25. Mr. Cullinan was 62 years old and joined the Western Electric Co. in 1901.

James Reed, Sr., president, Cramp Shipbuilding Co., died in Philadelphia July 24 at the age of 59. Mr. Reed was selected last year to head the Cramp concern when it organized its yards on the Delaware River for the production of U. S. warships. He was the builder of the Golden Gate Bridge at San Francisco.

August W. Sidell, retired demonstrator for Gisholt Machine Co., died June 30 at the age of 76. He was one of the earliest members of Gisholt's field organization, having served in this country and in Europe.

James H. Tobin, president and founder of the Tobin Tool & Die Co., Fond du Lac, Wis., died July 16.

ROBERT C. FARRINGTON

Robert C. Farrington, 59, chief mechanical engineer of the Austin Co., died at Fort Worth, Tex., July 15. He had been associated with the company since 1918. At the time of his death, Mr. Farrington was working on Army bomber plants in Texas.

MEETINGS

American Institute of Electrical Engineers. Pacific Coast convention. Canyon Hotel, Yellowstone National Park. Aug. 27-29.

American Society for Metals. Twenty-third National Metal Congress and Exposition. Convention Hall and Commercial Museum, Philadelphia, Pa., Oct. 20-24.

American Society of Mechanical Engineers. Fall meeting. Louisville, Ky., Oct. 12-15.

American Society of Tool Engineers. Semi-annual meeting. Royal York Hotel, Toronto, Canada, Oct. 16-18.

American Welding Society. Annual meeting and convention. Bellevue Stratford Hotel, Philadelphia, Pa., Oct. 19-24.

Exposition of Power and Mechanical Engineering. International Amphitheater, Chicago, Ill., Oct. 6-11.

Iron & Steel Exposition. Cleveland Public Auditorium, Cleveland, O. Headquarters Hotel Statler. Sept. 23-25.

National Association of Foremen. Eighteenth annual meeting. Cleveland, O. Sept. 19-20.

Society of Automotive Engineers. National Tractor meeting. Schroeder Hotel, Milwaukee, Wis., Sept. 25-26.

Society of Automotive Engineers. National Aircraft Production meeting. Biltmore Hotel, Los Angeles, Calif., Oct. 30-Nov. 1.

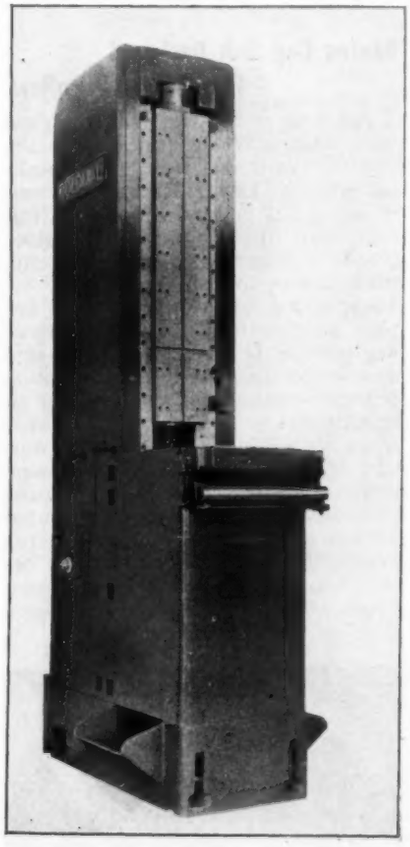
SHOP EQUIPMENT NEWS

Colonial Single Ram Broaching Machine Redesigned for Wider Range of Tooling

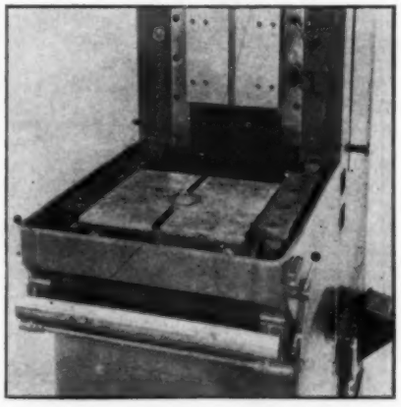
Increased size of work table and ram, and adaptability to a wider range of tooling than formerly are features of the new streamlined designs of single ram broaching machines now being introduced by Colonial Broach Co., 147 Jos. Campau St., Detroit, Mich. Normal capacities of the various sizes range from 3 tons and 36-in. stroke up to 25 tons and 66-in. stroke for the eleven standard models.

Column widths and work platen width have been increased, permitting increasing ram width, in turn providing better support for the wide bars frequently encountered in production. An entirely new cylinder design uses seamless steel tubing and welded construction for leak-proof operation. Another feature is the vertical mounting of the main drive motor inside the column, reducing the amount of floor space needed for installation.

Construction of the receding table mechanism is simplified to allow for effective installation of chip wipers. The new design of the table provides finish-machined pads on the front as well as on both sides for mounting auxiliary units such as cams used to automatically operate clamps, locks and support jacks on the fixtures. In the larger machines a longer travel of the receding table has been provided. A wider range of applications with increased safety of the operator is obtained, especially with broaches having deep or irregular contours. Control is all hydraulic on all machines. Automatic force feed lubrication system for the receding table bearings as well as the ram bearings has also been improved.



Redesigned broaching machine handles wider bars on larger table

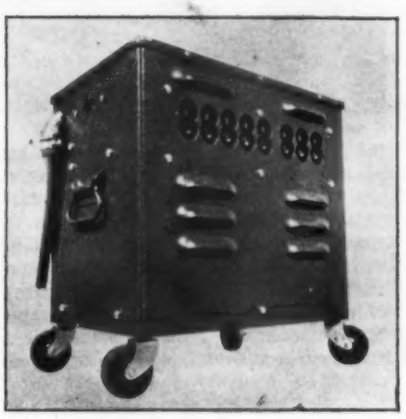


Auxiliary units can be mounted on table of Colonial broaching machine

Welded steel construction is utilized for the major parts such as the column and table. The increased use of steel castings in fabrication of the machines combines the flexibility of cast design with the inherent advantages of welded structures. For greater ease in installation, all machines are equipped with crane hooks.

Midget Marvel Flexarc Welder Handles Light Production

Known as the Midget Marvel WT-1, a new Flexarc welder for use in welding light gage metal, castings and drive shafts, general maintenance, and light production work is announced by Westinghouse Electric & Mfg. Co. This a.-c. welder comes complete with all accessories, even to the primary cable for hooking up the power line. Included in the accessories are electrode lead and holder, work lead and helmet.

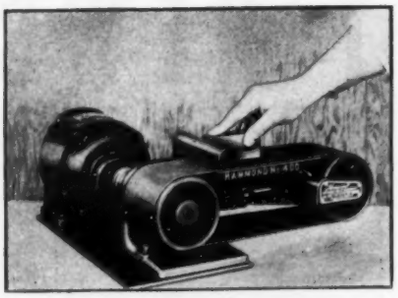


Sensitive adjustment of the welding current over a range of 20 to 140 amp. is provided by 15 steps with correctly proportioned increments between steps. Full load rating is 110 amp., 30 min., 30 load volts, when used on 220-volt, 60-cycle lines. The cost of power consumption averages about 5 cents an hour, depending on local power rate. The unit is very compact. Approximate dimensions are 14½ x 12½ x 20 in. long. Weighing only 160 lb., the welder is supported on castors.

Hammond "400" Belt Surfacer Handles All Types of Materials

Designed to reduce the number of rejects in lots of cast or molded pieces, and to facilitate finishing work formerly done by hand, a new bench type belt surfacer for wet or dry buffing, burring, surfacing, or polishing is now being manufactured by Hammond Machinery Builders, Inc., 1618 Douglas Ave., Kalamazoo, Mich. Versatility in the type and number of different materials successfully finished is an outstanding feature of the "400" machine. Plastics, stainless steel, ceramics, hard rubber, stone, lead, aluminum, wood and many other types of materials can be handled. With the proper abrasive belt, the machine can be used for rough work such as removing sprues and flash from rough castings. With a different type belt, a fine luster can be developed on glass, pottery, plastics and like materials.

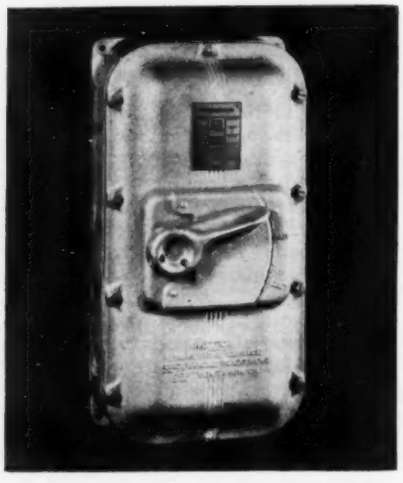
Base of the machine is heavy cast iron. Belts, of which a wide variety can be used, are 4x35 in. endless type, running over 4-in. drive and idler pulleys with 4½ in. face. Each pulley is dynamically balanced and turns on dust-proof ball bearings. Adjustable work rest positions work against the



belt. The machine operates in any position between horizontal and vertical, pivoting on center of the drive pulley and locking into position by means of a positive clamp on the base. For wet surfacing operations, a sheet metal casing is fitted around the machine. Coolant is piped to the belt by a tube inserted through the side of the hood and ending in a spray nozzle.

Westinghouse Interrupter Is Water and Dust Tight

Circuits in outdoor, damp, wet, or dusty locations can safely be disconnected or interrupted by a new non-automatic inclosed De-ion circuit interrupter just announced by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Inclosures (NEMA Types 4 and 5) are furnished in either cast aluminum or cast iron, both of which have an aluminized finish. A closely machined fit between handle shaft and bushing with heavy rubber gaskets



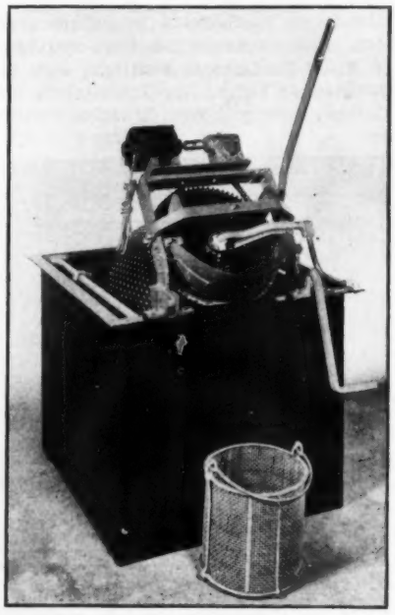
between inclosure and cover make them water tight.

A high interrupting capacity is provided to interrupt a circuit adjusted for 5,000 to 10,000 amp. depending on frame size. De-ion arc quenchers confine, divide, and extinguish arcs almost instantly. Quick make and quick break action is obtained by a toggle mechanism operating the contacts. Current ratings range from 50 to 600 amp., two or three poles, at 250 to 600 volts a.c. and 125/250 to 250 volts d.c.

Multi-Purpose Barrel Plating Unit Developed by Udylite

For a variety of purposes such as cleaning, drying, plating, rinsing or pickling, a new barrel plating machine known as the "Multi-Purpose" unit has been developed by Udylite Corp., 1651 E. Grand Blvd., Detroit, Mich. The cylinder is roomy, permitting large loads. Removal of cathode contacts for cleanings is a simple, quick operation. There are no bearings below the solution level.

For cyanide plating (cadmium, zinc) or electrocleaning, a plain steel tank with anode rods and terminals; steel steam coil if necessary; and a steel, rubber-covered cylinder with cathode

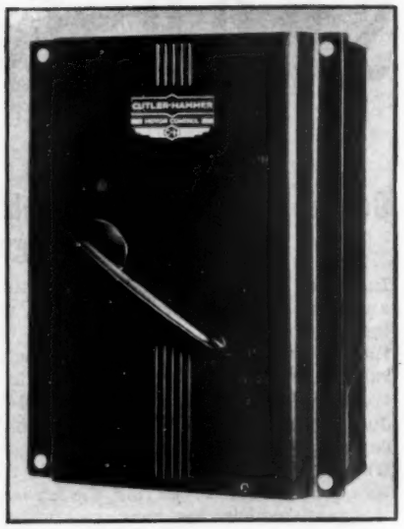


contacts are provided in the unit. For acid plating (nickel, etc.), a steel, rubber-lined tank with anode rods and terminals; lead steam coil if necessary; rubber-covered plating cylinder with cathode contacts is available. Tumble cleaning requires a plain steel tank, steel cylinder, steel steam coil. For pickling, the unit includes a steel rubber-lined tank, monel cylinder. For drying, a plain steel tank is equipped with a unit heater; cylinder is steel. Rinsing operations require a plain or rubber-lined steel tank; plain or rubber-covered steel or monel cylinder; and a steel or lead steam coil if necessary.

Tank is 32x36x30 in., of 3/16-in. steel welded inside and out, with 125-gal. capacity. Cylinder is 23x23 in.

Cutler-Hammer Introduces 230-Volt Multi-Breaker

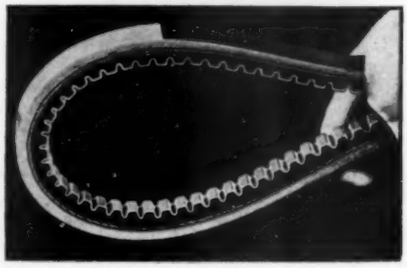
Cost of the new 230-volt industrial Multi-Breaker, designed by Cutler-Hammer, Inc., 315 N. 12th St., Milwaukee, Wis., is said to be little more than the cost of a Type A switch. This



new breaker affords economical application as a motor circuit switch or service disconnect switch. It is fuseless, with bimetallic strip actuation, visible trip indication, and trip-free lever. Rated capacity is 230 volts from 15 to 100 amp.; available in 3 pole, 3 pole solid neutral or 4 pole solid neutral type. Calibration is set at the factory and cannot be tampered with. The breaker is completely inclosed and semi-dust-tight. To save mounting space, access and operation are entirely from the front.

Dayton Cog Belt Designed For Flat or V-Pulleys

A new type of cog construction on the inner surface of the belt permits the new Dayton Cog-Belt of Dayton Rubber Mfg. Co., Dayton, Ohio, to be used on either flat pulleys or V-pulleys. Not only does this construction provide greater flexibility and longer belt life when flexing around small pulley diameters, but for V-flat drives it applies the scientific principle of increasing traction by means of a non-skid design. The patented cog construction provides greater grip and less slip on smooth flat pulley surfaces. Likewise, when riding in grooved pulleys, this new belt provides a greater gripping power with die-cut, raw edge sides which present the same undistorted driving surface to the pulley regardless of side wear. The new belt is being manufactured in all standard lengths in A, B, C, D and E cross-sections, and in matched sets.



Hydraulic Table Feed of Root Multiple Drill Gives Automatic, Continuous or Intermittent Feed

Designed to drill a large number of regularly or irregularly spaced holes over an area of 18x36 in., in steel, aluminum, cast iron, brass, plastics, or fiber, the Style F400 multiple metal driller of B. M. Root Co., York, Pa., has automatic, continuous or intermittent feed strokes with hydraulic table feed. Any table feed from 0 to 100 in. per min. can quickly be selected by the operator. The machine has rapid traverse, drill feed, and rapid return of the table.

Two convenient foot levers govern the table movement. A push-button station conveniently located controls the motors. Overloading the machine is impossible because of the automatic safety relief valve in the hydraulic circuit of the table feed. Rate of feed is governed by a hand-operated throttle valve.

Spindle speeds can quickly be adjusted by means of a screw and hand crank from 500 to 2,500 r.p.m. A ball-bearing motor mounted on a bracket on the back of the rectangular hood drives the keyed spindle drive shaft through a variable speed V-belt drive. Spindles are driven through heat-treated spiral cut gears. Any spindle can quickly be thrown out of gear to remain idle by an upward turn of the knurled knob at the top of the spindle. Ball-bearing spindles with ball thrust bearings are furnished where center distances will permit. Where the requirements of the job call for close centers, bronze bushings are specified. The machine will accommodate any number of spindles up to 16.

The foundation for the F400 multiple driller consists of a well-ribbed base of rugged construction on which is mounted a hollow cored deep section column which in turn supports a rectangular hood for the spindles. Table is all metal, slotted lengthwise and crosswise for T-bolts. Coolant pump, with integral motor drive and tank, provides adequate flow of coolant to each spindle. A channel around the edge of the table drains the coolant back to the reservoir.

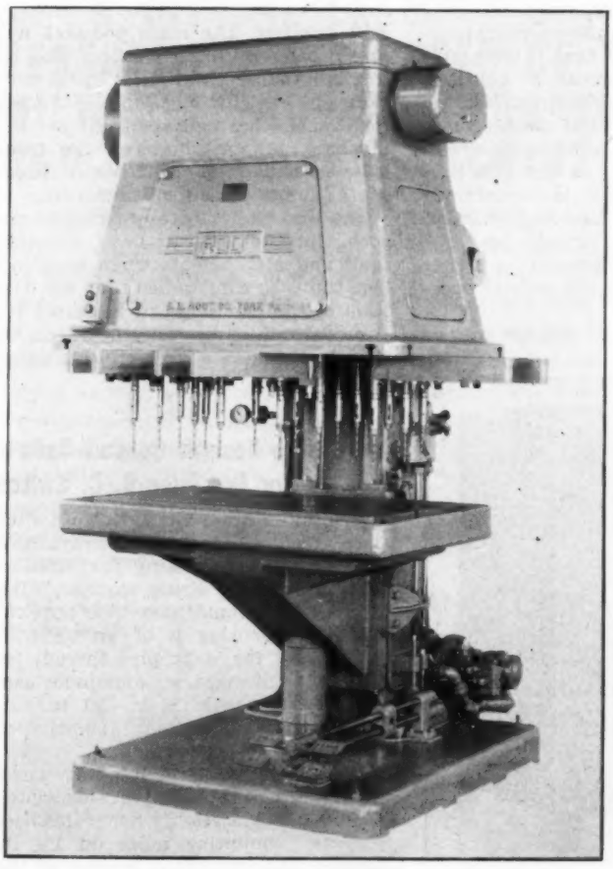
Verson Allsteel Knuckle Press Has Long Stroke and Adjustment

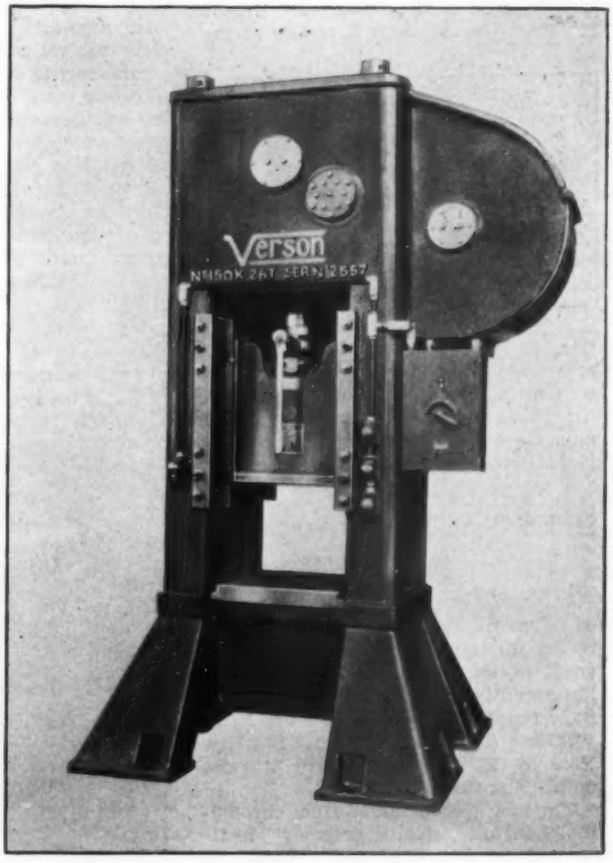
Providing a long stroke and long adjustment without sacrificing the desirable knuckle action of the more common type of knuckle joint and embossing presses, a new type of knuckle joint press has been announced by the Verson Allsteel Press Co., 93rd St. and South Kenwood Ave., Chicago, Ill. The frame of the press consists of four main sections, welded from quality steel plates into rigid box type units of great strength. These sections are keyed in place and tied together by four large steel tie-rods. The slide of the press is also of welded steel construction, box-type section, is guided in long gib ways and operates on renewable bronze liners. Bronze bearings are used throughout; the flywheel operates on anti-friction bearings.

The flexibility of this type of construction permits these presses to be manufactured in dimensions and capacities to suit the customer's specific requirements. The size illustrated has a capacity of 150 tons; a 5-in. stroke and a 5½ in. adjustment. The bed area is 26 x 26 in. and the press operates at a speed of 50 strokes per min. It is equipped with a full pneumatic clutch and brake unit with electrical push-button control for automatic operation. Various types of feed can also be adapted to this machine.

Black & Decker 9-In. Sander Designed for Heavy Service

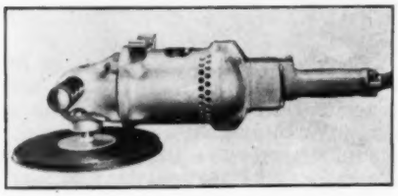
Black & Decker Mfg. Co., Towson, Md., have placed on the market a new 9-in. heavy-duty production sander designed to meet today's demands for faster schedules and more output per tool. Quicker change of pads and abrasive disks is made possible by a new, fast spindle lock. Husky, full-





powered universal motor operating on either a.c. or d.c., has a no-load spindle speed of 5,000 r.p.m.

Spiral bevel gears transmit power with a minimum of friction and noise. Switch and commutator are shielded against abrasive dust and grit. The plunger-operated switch is protected against accidental operation. All bearings are grease-sealed against dust and

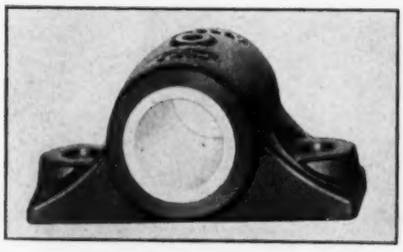


dirt; ball-bearings are specified throughout.

The new 9-in. sander is 2½ lb. lighter, shorter, and better balanced than previous units. A pusher type steel fan forces ventilation through ample vent slots; there is no dirt thrown into the operator's face. Adjustable side handle permits either right- or left-hand operations. A strap metal stand is also available.

Jeffry Improves Solid And Split Journal Bearings

Of accurate dimensions with modern rounded lines and smooth gunmetal finish, the new and improved solid and split journal bearings announced by Jeffry Mfg. Co., Columbus, Ohio, have machined bases and faced ends. Height to center-line of shaft is rigidly main-

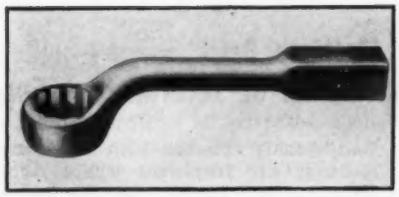


tained. Babbitted bores are broached to smooth hard surfaces and require no wearing in. Both styles are tapped for grease cups or pressure fittings. An ample storage groove in the top provides proper distribution of lubricant.

Striking Face Box Superrench Added to Williams Line

Particularly adapted for heavy work in close quarters where large nuts must be set up tight or "frozen" nuts loosened, a new striking box Superrench has recently been added to the line of Superrenches manufactured by J. H. Williams & Co., 225 Lafayette St., New York, N. Y. The offset head provides ample nut clearance.

The tool is drop-forged from chrome-molybdenum steel, properly heat-treated to withstand shock loads. It



is finished in baked gray enamel overall. Available in 10 sizes with 12-point openings, $1\frac{1}{16}$ to $3\frac{3}{4}$ in. for U. S. Standard nuts from $\frac{5}{8}$ to $2\frac{3}{4}$ in.

G. E. Announces Electroplating Rectifier, Voltage Regulator

Principal feature of the new 500-amp. fan-cooled copper oxide rectifier for electroplating service, and a separate "on load" voltage regulator manufactured by the General Electric Co., Bridgeport, Conn., is that the "on load" control permits adjustment during operation without interrupting the current flow in the plating tank. This is particularly helpful in plating bright nickel and certain other materials. Several sizes are available so that a number of parallel rectifier units can be controlled simultaneously from one regulator. The rectifier unit can be readily moved about and reconnected in various parallel arrangements to meet new conditions.

The rectifiers can be mounted singly or in groups, so that separate units can be used for each electroplating tank instead of large units serving several tanks as is customary with rotary equipment. The separate "on load" regulator gives the operator complete control at the tank. With this arrangement approximately full-load efficiency can be maintained because the rectifiers can be shut down on any tanks which are not being used. Overall full load efficiency is about 70 percent. This efficiency is maintained down to about half-load and falls off only slightly at 25 percent load. A power factor of 90 percent or better can be obtained over the normal operating range.

Two maximum d.c. voltage ratings

are available, in 6 and 12 volts. Standard units are designed for operation on 230 volts, 3 phase, 60 cycles; or on 440 volts, 3 phase, 60 cycles. Adjustments are provided to compensate for wide fluctuation of these line voltages.

Sellers Develops Cabinet Pedestal for Drill Grinder

A suitable pedestal of the cabinet type, with a work space approximately 13 in. wide by 30 in. long on which the machine can be mounted, has been brought out by William Sellers & Co.,

Inc., Philadelphia, Pa., for bench-type drill grinders. The main pedestal, approximately 31 in. from floor line to top, is constructed of sheet metal with sufficient weight and ample bracing to form a vibrationless mount for the machine. A steel door on the front gives access to a convenient three-shelf storage place for attachments.

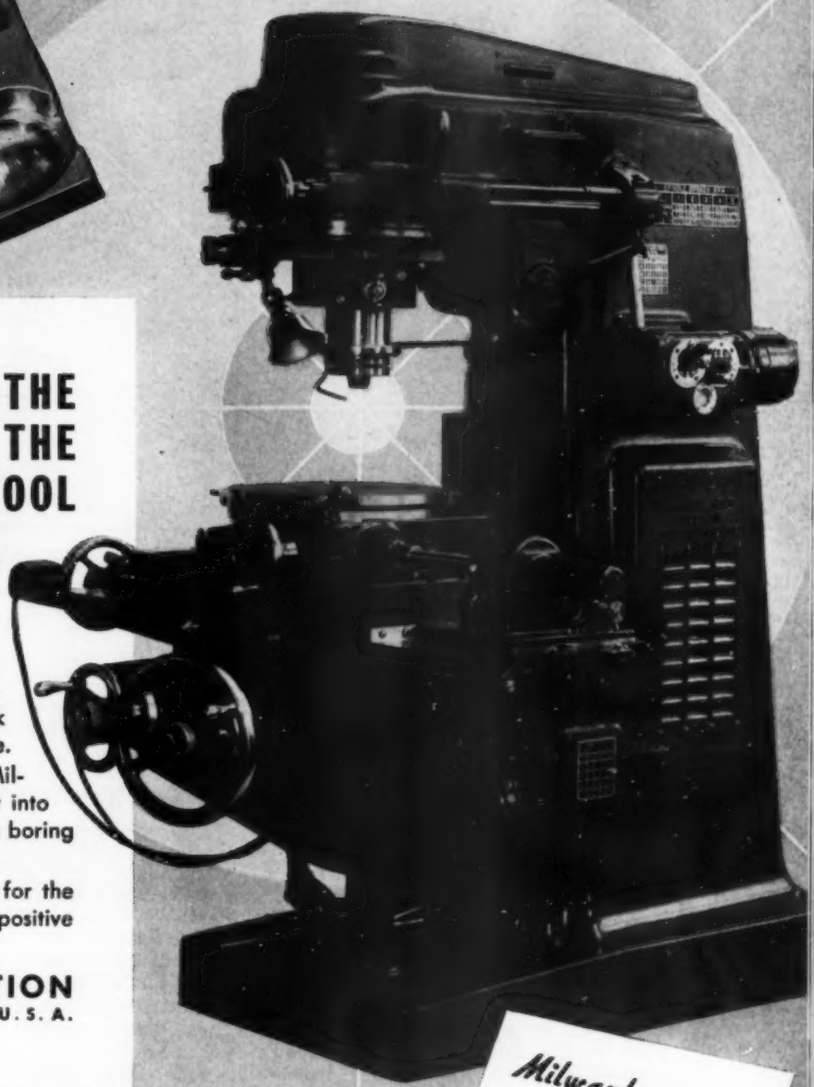
Top and shelves are of wood to absorb vibration and to avoid defacing tools and attachments when handling. The top is so constructed that the base level of the machine can be raised for the convenience of taller operators by the simple addition of a block under the machine.

Mu-Switch Designs Conduit Case For Precision D. C. Switch

The Type D Mu-Switch of Mu-Switch Corp., Canton, Mass., is now available in a cast metal housing for installation in conduit wiring systems. For industrial and machine tool applications, the housing is of bronze with hub tapped for ½-in. pipe thread; for aircraft application, an aluminum case is used with male ¾-in.—20 thread; others to specification. Dimensions over all are 1½x2¾x3½ in.

Access to the large binding screw terminals of this 2-kw. precision switch is provided by a readily removable base with two mounting holes on 1½ in. centers. An important feature of the

Completely Milled - TWO SIDES ..WITHOUT MODELS OR TEMPLATES!



. . . A TYPICAL EXAMPLE OF THE VERSATILITY AND SPEED OF THE MILWAUKEE ROTARY HEAD TOOL AND DIE MILLING MACHINE

The steel block, shown above, with its variety of geometric forms, was milled completely on both sides, without models or templates, in one setup on the Milwaukee Model D Rotary Head Tool and Die Milling Machine.

At no time during the entire milling process was the block moved from its original position in the milling machine vise.

This is another example of speed and versatility of a Milwaukee Model D — the machine that transmits blueprint into steel in a single setup — layout, milling, drilling, precision boring and slotting operations.

Investigate this machine and the new technique it offers for the production of dies and tools — in far less time, with positive accuracy, and at very low cost.

KEARNEY & TRECKER CORPORATION
MILWAUKEE WISCONSIN, U. S. A.

Milwaukee MODEL D ROTARY HEAD TOOL AND DIE MILLING MACHINE

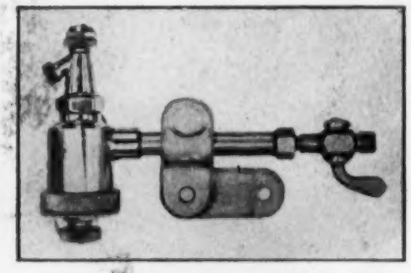
Milwaukee MILLING MACHINES

conduit style Mu-Switch is its built-in, blow-out magnet which quickly quenches the d.c. arc, thus prolonging contact life and obviating need for condensers or other external contact-protecting devices. Illustrated here is the Style DAP Mu-Switch with compression plunger over-travel mechanism capable of absorbing $\frac{1}{16}$ in. over-travel. Other types of actuating mechanism available are leaf spring, roller, and short-travel plunger.

Paasche Spray Devices Apply Graphite Lubricants

Lubricants containing dispersions of colloidal graphite can now be automatically sprayed on working surfaces by a new line of spray lubricating devices announced by Paasche Air Brush Co., 1909 Diversey Parkway, Chicago, Ill. The devices are provided with a universal mounting making it possible to adjust the lubricator to any desired position or angle, thus insuring uniform coverage.

Air-operated pistons controlling the spraying action can be started and stopped virtually instantaneously, providing accurate regulation of the amount of colloidal graphite lubricant

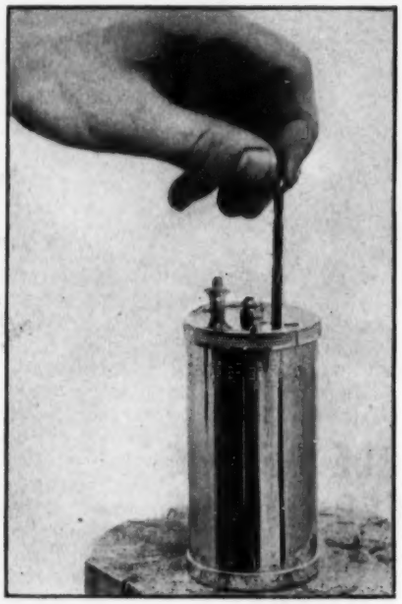


supplied. Intermittent operation as high as 150 shots per min. can be obtained. The automatic air brushes operate on a minimum of 35 lb. per sq.in. air pressure. Double action valve allows air to be discharged before the fluid needle valve is opened and air remains on until after the fluid needle seats. This assures perfect atomization of the colloidal graphite carrier. Seating of the fluid needle is positive, sealing the lubricant so that it can be retained in the gun and fluid line indefinitely without congealing or clogging.

The automatic air brushes are available in any one of three sizes or fluid assemblies for light, average or fast application, and with various sizes of multiple heads. Heads are adjustable for fan or cone spray. The latter permits adapting the spray guns to any of the carriers, such as oil, water, kerosene, carbon tetrachloride, commonly used in preparing dispersions of colloidal graphite.

Ingenious Drill Container Available from Burbridge & Sons

A drill container for eliminating the usual time-wasting search through a box of drills, "mikeing" for correct size, and loss of drills, has just been placed on the market by Burbridge & Sons,

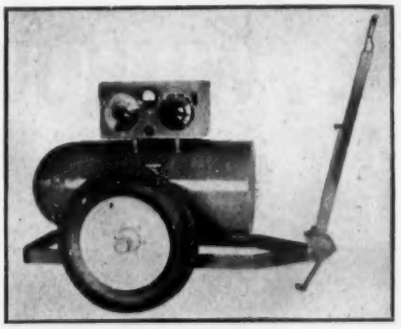


Kenosha, Wis. The container consists of a cylindrical case, only 5 in. high, and slightly over 2 in. in diameter. It fits any tool box and holds drills No. 1 to 60. Each drill, in a separate compartment, is made instantaneously available by turning the knurled top to the correct drill number.

New Two-Wheeled Trailer Mounts Lincoln Arc Welding Machines

Designed for mounting either Lincoln SAE 200-amp. to 600-amp. a.c. motor-driven or Type SA 200 special engine-driven Lincoln arc welders, a two-wheeled light-weight pneumatic-tired trailer for fast portability in shop, yard or on the road, has been announced by The Lincoln Electric Co., 12818 Coit Rd., Cleveland, Ohio. The new unit can be towed along a road up to 30 m.p.h., can be hitched to a factory mule or industrial truck, and is easily moved by hand. Low, underslung construction, narrow 31-in. tread and method of balancing facilitates maneuvering. It is of arc welded steel construction throughout.

Mounting is accomplished by four bolts in the frame of the trailer which register with holes in the lugs on the welding machine. The combination tow bar and standing support has a hand-operated ratchet arrangement



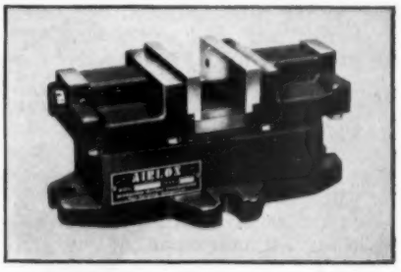
for locking the support arm in position. The unit measures 66 in. long, 42 in. wide, 16 in. high (over tires) and weighs 282 lb. Tires are 16 in. by 5.50 in., 4 ply.

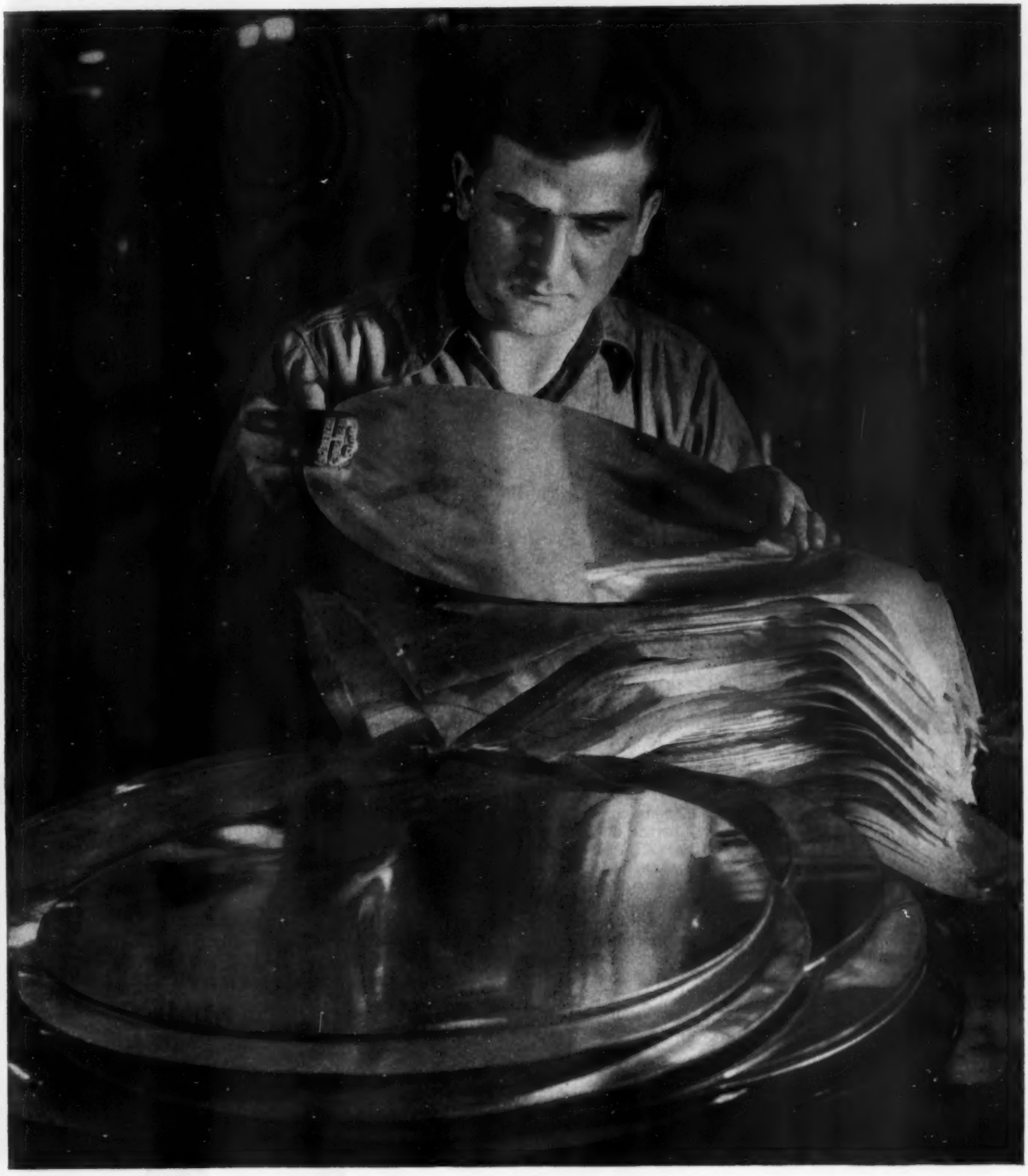
All Working Parts Shielded In Airlox Junior Production Vise

The Airlox Junior vise, just announced by Production Devices, Inc., 213 Comstock Building, East Hartford, Conn., is a precision-built production tool powered by a special Schrader air cylinder, and so constructed that the cylinder and mechanism are inclosed within the vise body and shielded from all contacts with chips, coolants and lubricants. Work is done over the approximate center of the vise table, insuring even distribution of weight on the milling machine table whether it is fastened crosswise or lengthwise. Machined surfaces on the top of the vise jaws permit the attachment of special fixtures.

An instantly adjustable screw on the removable jaw, located in the middle of the end of the vise, enables the operator to set the jaw opening so as to grip the work during the last $\frac{1}{16}$ in. of jaw travel, thereby obtaining the maximum gripping pressure of 20 times the air line pressure. Bolts can be adjusted to lock the other jaw firmly in place.

These vises are regularly supplied with No. 1 Brown & Sharpe jaw hole spacing, and soft jaw facing. They can also be supplied with undrilled jaw castings for fitting to any jig facing. Length over all is 10 in.; width over all is 5⅞ in.; height over all is 4¾ in. Jaw width is 4¼ in.;



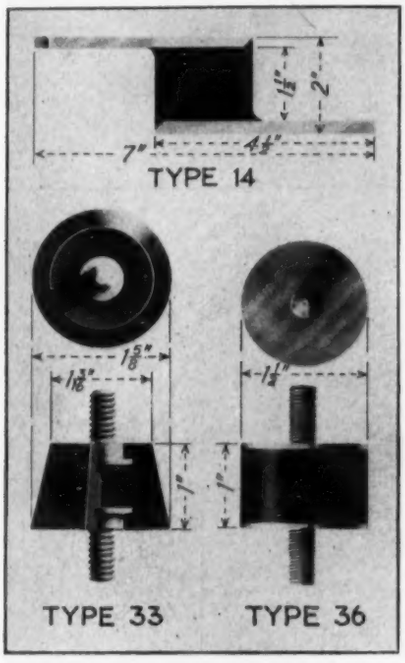


A "BRASS HAWK". When Revere Copper and Brass Incorporated receives your order, a corps of men take your interests in charge. Acting virtually as an arm of your own organization, they watch the materials in your order through each production stage, from casting shop to shipping platform. One of these "brass hawks" is Dominick Lombino, schooled in the critical inspection methods developed by Revere. His skill, in knowing what to look for in copper and copper-base alloys, helps to make Revere products so trustworthy. He, and dozens of inspectors like him, are a part of the painstaking Revere service which is now showing its value for defense by insuring the fitness of the materials you order from us. Revere Copper and Brass Incorporated, 230 Park Avenue, New York.

jaw depth is $1\frac{7}{8}$ in. Movable jaw travel is ½ in. Usable jaw opening is $2\frac{1}{8}$ in. between jaw faces, 3 in. between jaw castings. Special alloy castings give high strength.

B. F. Goodrich Adds Three Rubber Vibro-Insulators

Three new Vibro-Insulators, the devices of rubber and metal which decrease vibration and noise in machinery mountings of many types, have been added to the line of B. F. Goodrich Co., Akron, Ohio. Type 14 is recommended for a load in vertical shear of 80 lb. per sq.in., deflection in shear of 1 in. at a loading of 80 lb., and minimum disturbing frequency at this deflection of 470 per min. This type can also be supplied with the rubber in compression, by placing the



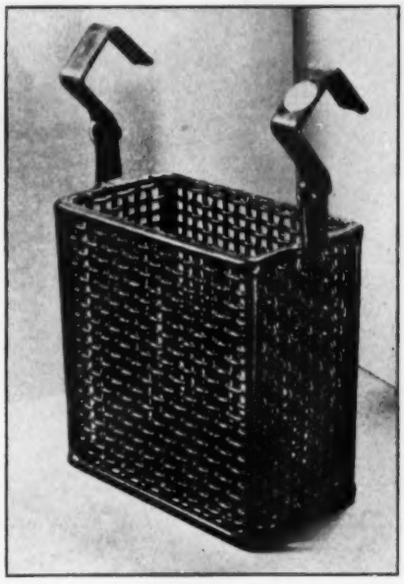
metals in a horizontal position. Maximum recommended load under compression is 250 lb. per in., deflection at that loading is $\frac{5}{16}$ in. and the minimum disturbing frequency at that deflection 850 per min.

In Type 33 the rubber is applied only in compression, with maximum loading of 150 lb., deflection at that point $\frac{1}{2}$ in., and minimum disturbing frequency at that deflection 1,200 per min.

Type 36, although best adapted for work with the rubber in compression, can also be applied in shear. With 35 and 50 durometer hardness, loading beyond 20 per cent of the rubber thickness, or 0.175 in. is not recommended. Under this load the minimum disturbing frequency is 1,250 per min. and the load necessary to deflect 35 durometer mounting is 100 lb., and for 50 durometer mounting 85 lb. These are maximum load limits with lower loads recommended where possible, especially where the disturbing frequencies are greater than 1,250.

Anode Scrap Baskets Developed By Hanson-Van Winkle-Munning

In a new type of basket for handling scrap anodes recently announced by the Hanson-Van Winkle-Munning Co., Matawan, N. J., the stubs of used anodes are placed in the basket around



a new anode, allowing the stub metal to be completely used. Because of the present shortage of metals, this efficient use of scrap is of vital importance.

The scrap anode basket is furnished with two hooks, allowing the basket to be hung on anode rods in still tanks and plating barrel tanks. The new anode inserted in the basket is hung on the anode bar. The basket is made of steel wire with proper reinforcements at the top, at all ends, and at the bottom. The steel mesh is welded to the frame and the entire basket is rubber covered. The unit is rugged in construction and neat in appearance. Baskets can be used in solutions where temperature does not exceed 180 to 190 deg. F. Standard sizes have inside dimensions ranging from 9x18x4 in. to 20x40x4 in.

Electric Brazing with Silver Now Possible with Ideal Brazer

A new electric brazer for brazing and soldering with silver solder is now available from the Ideal Commutator Dresser Co., 1057 Park Ave., Sycamore, Ill. The brazer, consisting of a pair of electric heating pliers and a power unit or transformer, operates on the same principle as the Ideal Thermo-Grip self soldering tool. The part is quickly brought to brazing temperature by gripping it firmly in the pliers. Heat is accurately controlled by a foot switch.

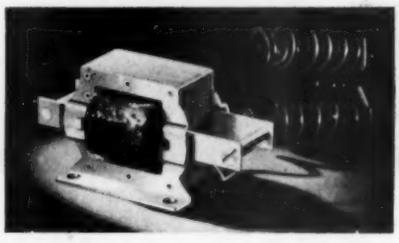
The Ideal brazer is compact, portable, easy to use, and is always ready in the shop or the field. When in use the cover turns back making a con-

venient shelf for flux and silver solder. Compartments are provided for pliers, foot switch, silver solder and flux, so that when not in use all parts can be inclosed within the streamlined cabinet. The cabinet is mounted on rolling casters. Overall size is 14x12x25 in.

The brazer operates on 230 volts, 50-60 cycle a.c. supply. Units for 440 volts and 25 cycles are also available. Rating is 7½ kva. Secondary voltage is reduced to only 10 volts. Heating pliers have a 6¼-in. long throat. Face of carbon is 1¾x2 in., and can be filed to the shape best suited for any particular job. These jaw ends can easily be changed when changing jobs.

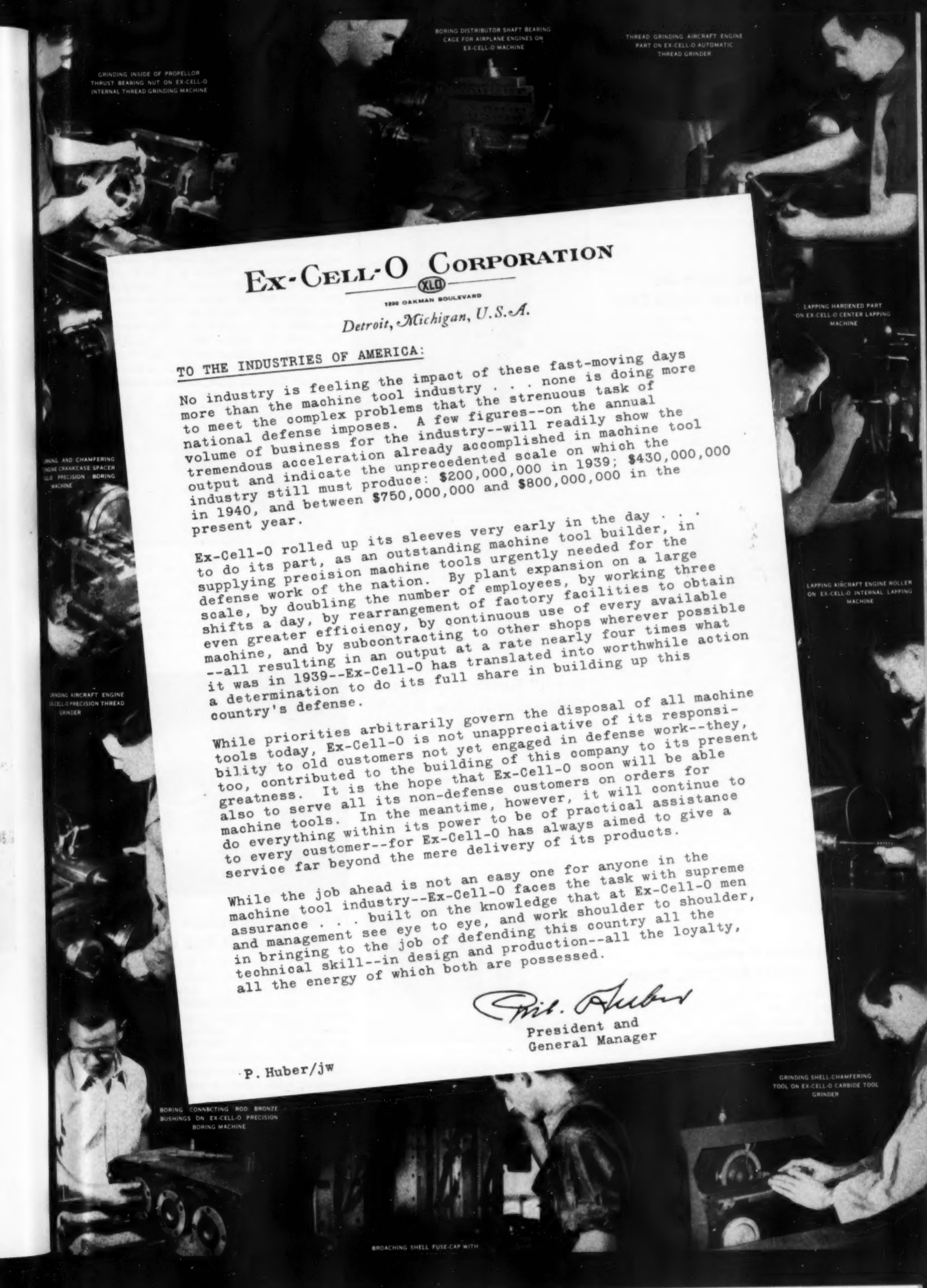
John S. Barnes Introduces Solenoid for Machine Tools

An improved solenoid designed primarily for machine tools is now available from John S. Barnes Corp., 301 So. Water St., Rockford, Ill. The solenoid cannot be harmed by oil or coolant; the cloth taped coil is impreg-



nated with oil and water resistance varnish. The improved construction is more rigid, with integral feed and side plates, and more and heavier rivets. The mechanical structure is also made much stronger. Plunger guides are now made of phosphor bronze.

The pull exerted by the PA-3945-C solenoid plunger at 110 volts ranges from a maximum of 23 lb. at zero stroke to 5 lb. when the plunger is extended 1 in. Corresponding current


GRINDING INSIDE OF PROPELLOR THRUST BEARING NUT ON EX-CELL-O INTERNAL THREAD GRINDING MACHINE
BORING DISTRIBUTOR SHAFT BEARING CAGE FOR AIRPLANE ENGINES ON EX-CELL-O MACHINE
THREAD GRINDING AIRCRAFT ENGINE PART ON EX-CELL-O AUTOMATIC THREAD GRINDER
LAPPING HARDENED PART ON EX-CELL-O CENTER LAPPING MACHINE
LAPPING AIRCRAFT ENGINE ROLLER ON EX-CELL-O INTERNAL LAPPING MACHINE
GRINDING SHELL-CHAMFERING TOOL ON EX-CELL-O CARBIDE TOOL GRINDER
BORING CONNECTING ROD BRONZE BUSHINGS ON EX-CELL-O PRECISION BORING MACHINE
BROACHING SHELL FUSE-CAP WITH

EX-CELL-O CORPORATION

1200 OAKMAN BOULEVARD

Detroit, Michigan, U.S.A.

TO THE INDUSTRIES OF AMERICA:

No industry is feeling the impact of these fast-moving days more than the machine tool industry . . . none is doing more to meet the complex problems that the strenuous task of national defense imposes. A few figures--on the annual volume of business for the industry--will readily show the tremendous acceleration already accomplished in machine tool output and indicate the unprecedented scale on which the industry still must produce: $200,000,000 in 1939; $430,000,000 in 1940, and between $750,000,000 and $800,000,000 in the present year.

Ex-Cell-O rolled up its sleeves very early in the day . . . to do its part, as an outstanding machine tool builder, in supplying precision machine tools urgently needed for the defense work of the nation. By plant expansion on a large scale, by doubling the number of employees, by working three shifts a day, by rearrangement of factory facilities to obtain even greater efficiency, by continuous use of every available machine, and by subcontracting to other shops wherever possible --all resulting in an output at a rate nearly four times what it was in 1939--Ex-Cell-O has translated into worthwhile action a determination to do its full share in building up this country's defense.

While priorities arbitrarily govern the disposal of all machine tools today, Ex-Cell-O is not unappreciative of its responsibility to old customers not yet engaged in defense work--they, too, contributed to the building of this company to its present greatness. It is the hope that Ex-Cell-O soon will be able also to serve all its non-defense customers on orders for machine tools. In the meantime, however, it will continue to do everything within its power to be of practical assistance to every customer--for Ex-Cell-O has always aimed to give a service far beyond the mere delivery of its products.

While the job ahead is not an easy one for anyone in the machine tool industry--Ex-Cell-O faces the task with supreme assurance . . . built on the knowledge that at Ex-Cell-O men and management see eye to eye, and work shoulder to shoulder, in bringing to the job of defending this country all the technical skill--in design and production--all the loyalty, all the energy of which both are possessed.

P. Huber

President and
General Manager

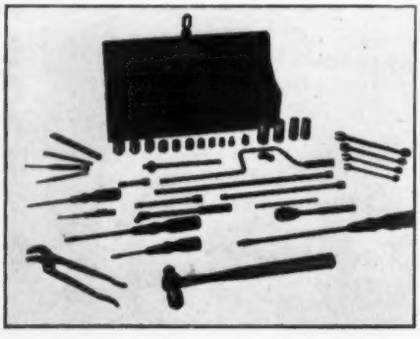
P. Huber/jw

flowing in the solenoid at 110 volts for corresponding strokes and pulls ranges from 0.76 amp. at zero stroke to about 5 amp. at 1 in. To avoid over-heating, the solenoid should be used so that any current flow in excess of the minimum is momentary only. Furthermore, the solenoid should not remain energized with a current of 0.76 amp. for intervals in excess of 10 min. even though allowed to cool between intervals.

Bonney Tool and Socket Set Has 40 Light-Weight Pieces

Bonney Forge & Tool Works, Allentown Pa., has just announced their TD6 light-weight socket and tool set. Sockets and attachments are all in ⅜-in. square drive, made of "CV" chrome-vanadium steel and chrome plated. All pieces are packed in a strong metal box which has a removable tote tray, carrying handle, end catches and padlock hasp.

Containing 40 pieces, it includes 10 sockets with double hexagon openings



from 5/16 to ⅞ in.; 4 extra-deep sockets with ⅝, 11/16, and ⅞ in. double hexagon openings; universal joint, 3, 6, 12 and 17 in. extensions; 17½-in. speeder; drag link socket; 8½-in. hinge handle; 6-in. crosshandle; 7-in. reversible ratchet; 8-in. sliding "T"; 4 Bonaloy TuType (combination box and open end) wrenches with 7/16, ½, 9/16 and ⅝-in. openings; Channellock Adjustable Pump Plier with ½ to 1⅞ in. capacity; 4 assorted punches and chisels; pocket size screwdriver with neon tube; four wood-handled screwdrivers of various sizes and a ¾-lb. ball pein hammer.

Light-Weight Protectocoat Resists Acids, Oils, Greases

American Optical Co., Southbridge, Mass., has just announced a new protective apron claimed to be different from conventional oiled duck, rubberized cloth and synthetic types. The material of this new Protectocoat provides effective protection against acids, oils and greases. In addition to protecting the worker's clothing, it guards his person against contact with industrial compounds and liquids that cause skin diseases and discomfort. It re-

sists heat, will not burn. Although very tough, it is also light in weight, assuring comfort and durability. It is made in two styles and 11 sizes. Specifically, the Protectocoat resists oils, tar, greases, acids, chemicals, paints, varnishes, lacquers, cutting fluids, solvents, kerosene, gasoline, creosote, naphtha, caustics and alkalis.

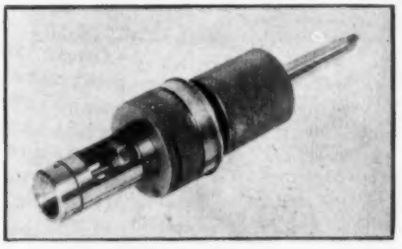
"Time-It" Electric Stop Watch Announced by Precision Scientific

For application in time study operations, laboratory procedures, motor dynamometer tests and others, this new "Time-It" minute model electric stop watch, announced by the Precision Scientific Co., 1750 N. Springfield Ave., Chicago, Ill., is run by a synchronous electric motor which operates a direct reading indicating counter.

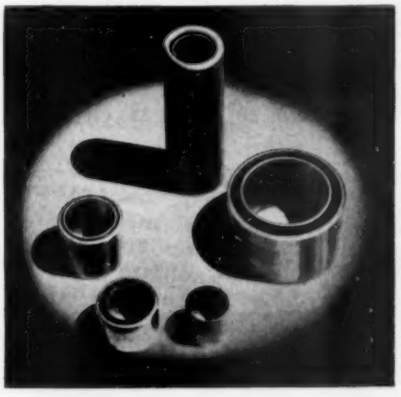
Accuracy is covered by the cycle constancy of 115-volt a.c. supply. The device integrates to 1000 min., reading in full minutes and hundredths of a minute. It can be reset to zero from any reading or successive readings can be made cumulative.

Centering Chuck for Drill Press Announced by Universal Engineering

A centering machine can be made out of almost any medium sized drill press with a new tool called a centering chuck, available from the Universal Engineering Co., Frankenmuth, Mich. Bushings in the chuck are beveled at a 45-deg. angle, forming a conical surface that fits over the ends of shafts to be centered. This cone locates the shaft centrally and the bushing guides the center drill. There is a feed-out adjustment on the chuck to regulate the depth of the center drill so that centers will be uniform. It is only necessary to chamfer the burrs from the shaft to secure uniform centers with few thousandths of an inch variation in depth. Work from a screw machine that has been centered in one



end can be set on a drill press with a center point in order to center the opposite end rapidly with the centering chuck. A convenient arrangement is provided for removing center drills and guide bushings in a few seconds.



Torflex Bearings Available With Bronze on Steel Bushings

Made with inner walls of a new, thinner material of either plain or graphited bronze on steel, a new line of Torflex bearings, announced by Harris Products Co., 5408 Commonwealth Ave., Detroit, Mich., are recommended for applications where the Torflex construction is required to fit into a smaller space. Increased resistance to pounding and shock, a comparatively low coefficient of friction, and a considerably wider range of sizes and shapes on shorter notice than the older cast styles, are features.

The increased shock resistance of the

new bearing material, together with the Torflex rubber backing, is expected to permit the combination to be used in applications where excessively high impact and shock are present and where cast bronze bearing material alone would not stand up. Availability of a new bearing material in sheet form insures faster delivery because the required sizes can readily be cut from sheets, shaped, and quickly assembled with the rubber insulating wall and outer wall.

The rubber wall surrounding the center inner wall section can be made in almost any thickness necessary to handle radial loads, or to compensate for misalignment, to stop vibration and transmission of noise, and to meet similar requirements.

NEW MATERIALS

Truscon Rubber-Base Paint Protects Metals from Corrosion

Paratex metal coating, recently developed by the Truscon Laboratories, Detroit, Mich., is a chlorinated rubber base paint, especially adapted to all types of exposed iron and steel. The coating can also be applied to protect aluminum, copper and galvanized metals, and is expected to replace conventional types of metal paints because of its exceptional durability and resistance to rusting and corrosion. Because of its chlorinated rubber composition, Paratex is more resistant to acids, alkali, fumes and chemicals than conventional oil paint. Paratex paints use only pigments which are inhibitive or neutral to steel corrosion. Also, the formulation of Paratex primer is reinforced with rust-inhibitive elements so as to provide maximum rust protection.

One unusual feature of the Paratex metal primer is that, when it is applied over scales of rust and paint that do not have true adhesion to the surface, the primer penetrates and works its way laterally under those scales and turns up the edges into view. This feature shows up the defects of a priming job at once, ratner than months later.

Paratex coating and primer is available in all standard size containers, and in standard colors of red, light gray, light green, steel gray, dark green, braown, white and black.

Unichrome Copper Plating Offers Time-Saving Features

Significant as a plating finish for replacing nickel heretofore used in plating and now unavailable because of national defense, a new Unichrome alkaline copper plating process has been announced by United Chromium, Inc., 51 E. 42nd St., New York, N. Y. With this time and labor saving process, smooth, fine grained deposits

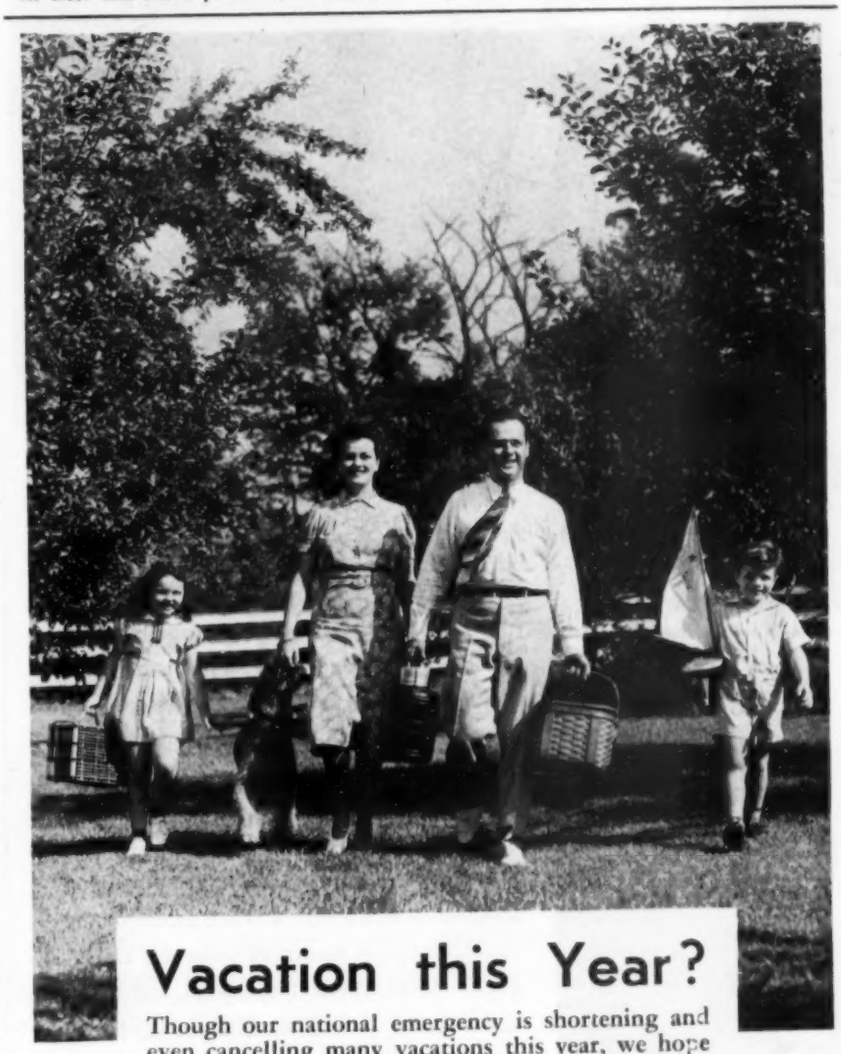
(Advertisement)

Manufacturers Look to Steel Warehouses for Quick Defense Requirements

Many leading manufacturers are relying on nearby steel-service plants for prompt, stock shipment of steel to meet the current surge of business prompted by our National Defense Program.

Probably the leading exponent of "Immediate Steel" is Joseph T. Ryerson & Son, Inc., with their net work of ten strategically-located plants, each of which is completely equipped for prompt service on steel and allied products, formed and cut to customers' exact requirements. No shop would be without the Ryerson Stock List (see advertisement below).

Thousands of manufacturers report saving considerable time, trouble and money by taking advantage of Ryerson's complete flame cutting service. Modern equipment manned by specially trained operators can quickly burn any shape—no matter how intricate—from carbon or alloy steel plates and billets up to 15" thick.



Vacation this Year?

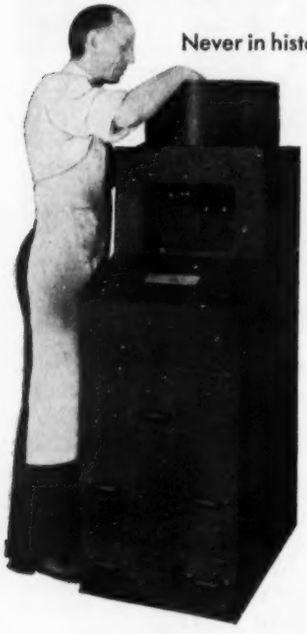
Though our national emergency is shortening and even cancelling many vacations this year, we hope you'll be able to slip away for a few days at least. While you're gone, your department can rely on Ryerson for the best steel-service that present-day circumstances will permit. In times like these, we are naturally out of many sizes but we still have a fair stock and service continues without interruption.

So make the most of your days off . . . Relax! Build yourself up for the hard winter months ahead. Ryerson will help hold the fort.

Joseph T. Ryerson & Son, Inc.

***Plants at:* Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Boston, Philadelphia, Jersey City**

Locomotives have improved vastly since those ambitious little wood burners struggled across the Union Pacific in the early 70's. The streamliner of today can do far more and do it much faster.



Never in history has progress been made more rapidly in precision gaging than in the last few years. Both standards of accuracy and gaging speed have made spectacular advances. The human equation, such an unpredictable factor just a few years ago, becomes much less troublesome.

Sheffield has its part in this march of gaging progress. It was Sheffield which produced the automatic gage illustrated—also the Electrigage, the Multichek Electrigage, the Precisionaire, the Thread Lead Checking instrument and others. If you are not familiar with what these instruments have accomplished in increased accuracy and faster inspection, write us for the story.

THE SHEFFIELD CORPORATION
Gage Division · DAYTON, OHIO, U.S.A.

SHEFFIELD MASTER GAGEMAKERS

can be plated to thicknesses of 0.001 in. or more. It buffs easily, with minimum pressure and is often used without buffing prior to bright nickel plating. No special cleaning or activation is required for subsequent plating. Bath operates at moderate temperatures and is non-corrosive.

The Unichrome alkaline copper plating bath is operated at moderate temperatures of about 100 to 140 deg. F. Current densities range from 20 to 40 amp. per sq.ft. at a tank voltage of 1 to 2 volts. For some types of work higher current densities and voltages are applicable. Cathode as well as anode current efficiency is 100 per cent. The bath constituents are stable and easy to control.

A rubber or brick-lined steel tank provided with air agitation is recommended for this process. Heating coils are generally used, and external heat exchangers are recommended for large installations. The usual filtering is employed. Preliminary cleaning treatment for this process does not vary much from normal procedure. With steel or die castings, a copper strike is recommended.

TRADE PUBLICATIONS

BELTING The B. F. Goodrich Co., Akron, Ohio, has just published a new catalog section on its line of multicord belting. Construction and advantages of this type belt, tables of minimum pulley diameters and approximate weights of 100 ft. lengths of varying widths, are all included.

COMPRESSORS Pennsylvania Pump & Compressor Co., Easton, Pa., is circulating a 24-page booklet, No. 192, which illustrates and describes the construction features of horizontal duplex heavy duty compressors.

COMPRESSORS Worthington Pump & Machinery Corp., Harrison, N. J., is offering an 18-page booklet, No. S-550-B19, which illustrates, describes and provides dimensions for angle engine compressors.

CONTROL ACCESSORIES Bulletin No. 89-14 announced by the Brown Instrument Co., Philadelphia, Pa., provides dimension tables, schematic diagrams, sizing chart for gas valves, liquid flow valves and seam valves, and a table of the shipping weight for various items of control accessories for pneumatic controllers.

FEED FINGERS AND PADS Hardinge Brothers, Inc., Elmira, N. Y., is circulating a four-page leaflet which illustrates, describes, provides specifications and list prices of Morrison master feed fingers and pads.

FIXTURES The Thompson Electric Co., 1101 Power Ave., Cleveland, Ohio, has published a 40-page catalog, No. 41,

which illustrates, describes, provides specifications and indicates the application of hangers, hanger accessories and suspension devices, shock absorbers, concealed mounting units, chain and cable for lighting fixtures.

FUSES Cutler-Hammer, Inc., 315 N. 12th St., Milwaukee, Wis. is circulating a new booklet "Good-bye to Fuses," which tells all about modern electrical protection for lighting circuit power. In a series of short, non-technical stories, it explains the necessity of electrical protection and how the new multi-breaker does the job.

PUMPS Bulletin No. W-304-B2, circulated by Worthington Pump & Machinery Corp., Harrison, N. J., illustrates, describes and provides specifications of the construction of centrifugal pumps.

NEW BOOKS

THIRTY-TWO METAL SPINNING DESIGNS —*By Harold V. Johnson, instructor of vocational and industrial arts, Canton (Ill.) High School. 102 pages. Published by the Bruce Publishing Company, 540 N. Milwaukee St., Milwaukee, Wis. Price, $2.*

Spinning is one of the oldest methods of forming metals. It was practiced by the Chinese, the Greeks and the Romans. It was introduced as a trade in England during the reign of King Edward III.

This volume is designed to assist the teaching of spinning as an industrial art. It consists mainly in a description of a number of simple articles that can readily be made by this process.

In addition, introductory chapters on the origin of metal spinning, on tools and materials and on fundamental methods are included. Since many of the objects are suitable for home use, the volume should be of interest to the home craftsman as well as the student.

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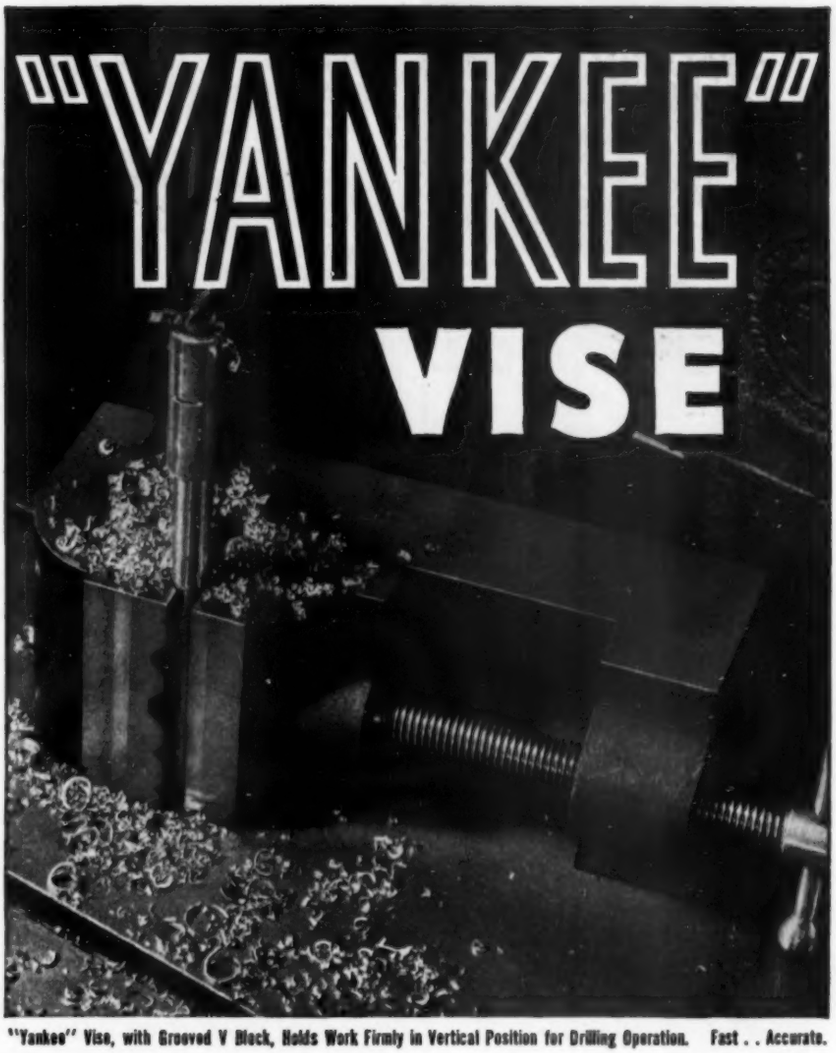
HANDBOOK OF WELDED STEEL TUBING— *86 pages. Published by Formed Steel Tube Institute, 1621 Euclid Ave., Cleveland, Ohio. $1.00.*

This handbook has been published to furnish design engineers with information regarding standard sizes and properties of welded steel tubing. It is devoted exclusively to those grades of welded tubing which can be figured as having a solid wall structure with no discontinuity or variation in physical properties occurring in the area affected by the welding operations during manufacture. Standard sizes, together with commercial tolerances for roundness, wall thickness, straightness and other properties, are tabulated for various grades of welded tubes.

The manufacturing and fabricating processes are illustrated and drawings



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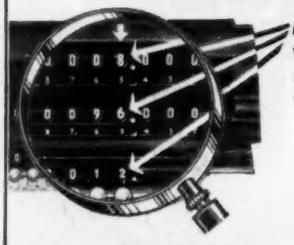

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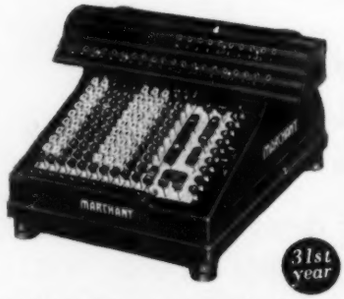

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show on typical examples to what degree welded tubing can be cold worked in such operations as bending, beating, flanging, expanding and tapering. Special attention is given to recommendations for laying out fabricated parts and methods of checking. A number of suggestions are incorporated in this handbook which will aid in developing designs for the most economical use of tubular sections. Illustrations show the variety of possibilities for using tubular members in many industries.

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ENGINEERING DRAWINGS — *By D. E. Hobart, assistant professor of mechanism and engineering drawing, University of Michigan. 430 pages. Published by D. C. Heath and Company, 285 Columbus Ave., Boston, Mass. $2.75.*

This book is designed especially for the student who requires a complete understanding of engineering drawing. While short cuts are being devised to give young men a quick working knowledge of blueprint reading and even of drafting, there is still a need of books for those who require a sound footing in the subject as a part of their technical education. Professor Hobart's book starts with drawing instruments and methods of lettering. From there it traces applications of geometry and graphic projection.

The volume deals also with engineering conventions, standardization and various topics with which the well equipped engineer must have a working familiarity. Departing from the purely mechanical phases of the subject, the author also treats of maps and construction drawings. Problems on the subject matter are also included.

SEEN and HEARD

By JOHN R. GODFREY

Rapid Thread Grinding

THREAD GRINDING is one of the most startling developments to those who recall the feeble attempts to grind work in a lathe, fifty years ago. With that recollection in mind, the statement of Ralph E. Flanders that with proper conditions the grinding wheel can remove metal faster in heat-treated work than it can be milled in soft steel, is startling in the extreme.

Internal Strains

HIDDEN STRAINS IN METAL make all kinds of trouble. Castings and forgings are both unknown quantities to some extent no matter how careful we may be. Letting castings "age" in the yard after roughing cut, used to be common practice. Then the method was tried of heating them to about 900 F. for a few hours to relieve the strains. In some cases it helps to tap the casting with a mallet after removing it from the machine. But probably no amount of tapping would have saved a long planer bed that snapped in two with a report like a gun, standing on the floor ready to be shipped. No one was near it nor had it been dropped, as some imagined. The little molecules did a bit of team work, and the bed was in two parts.

Nor are metals the only materials that go on a rampage. Plastics also get similar notions. And I've seen a spare tire on the back of a car let go with no one near it.

Light and Dark Shops

ONE OF THE most striking contrasts between new and old machine shops is in the lighting. Going from such a shop as that of the new Pratt & Whitney plant to some built a quarter century or more ago, is almost as much of a contrast as from daylight to Luray Caverns. It is hard to see how some of these dark shops turn out as accurate work as they do. The contrast is most depressing. It isn't all a matter of windows because the new Simonds plant hasn't any. Whether we have daylight or electric lamps, there should be enough to give adequate illumination on the work and the machines.

Chemistry in the Shop

CHEMISTRY shows its influence in all sorts of shop work, as in other walks of life. This time it is in cutting compounds for hard steels. Carbon tetrachloride, the grease remover and fire extinguisher which is sold under a variety of fancy names, also has its uses as a cutting compound. Then there is chlorine which helps make water that isn't fit to drink so it can be used without causing an epidemic, which also helps in machining hard materials. The fly in the ointment is that it's hard on the operators unless its effect can be counteracted by more chemistry. Chlorinated oils are, however, among the possibilities for special work.

Selective Assembly

ALTHOUGH WE TALK GLIBLY of interchangeability, some of our mass production parts require greater accuracy in fits than it is practicable to get without selective assembly. Such cases are pistons, piston pins, gear and shaft fits in transmissions and other parts of even the lower priced automobiles. By this method we get cars built with greater accuracy than ever before and at much lower prices.

About Tapers

MEMBERS OF THE Taper Standardization Committee who worried for years over slight variations in Morse and others, should have been with me recently in a Florida repair shop. The machinist,

and apparently a good workman, was turning the taper on a propeller shaft, on an old Prentice lathe. "Best taper attachment I ever used. Making this a Morse taper, ¾ in. to the foot. I tried to tell him it was the same as a pipe thread taper! I'm wondering if he ever tried to use a ¾-in. taper in a drill press spindle—and how it worked.

Old Man Johnson and Who Makes What

By JOHN R. GODFREY

Old Man Johnson has joined the dollar-a-year men. He's been playing around with machine tools and shop equipment in general so long that they use him as a sort of walking cyclopedia. They have him tucked away in an office with a bank of catalog files, card indexes and a secretary who knows how to handle them—and probably the Old Man as well. Or so it seemed when I dropped in the other day.

"What am I doing here Godfrey? Might be easier to list the things I'm *not* doing. No, I haven't any flossy title. Some call it Technical Adviser, which sounds good but doesn't make that dollar buy any more postage stamps. If I was putting up a sign I'd call it the WHO MAKES WHAT department. As a sort of sub-title I'd tack on—AND HOW GOOD IS IT.

"I like the job—but I do get sore sometimes at the way some machine builders use fancy names for their tools. May seem like a little thing but if you knew how much time it wastes—when time is of the essence as some old guy said years ago—you'd get sore too. You can't expect clerks who never saw machine tools, to know the difference between a bench lathe that costs $69.75 and one that costs $1,000 without any attachments. Or to know that a chamfering machine and gear tooth rounder are the same in most cases.

"Then the way they murder the term automatic is a crime. If a simple turret has a knock-off dog that kicks out the feed at the right point, some makers stick an automatic on it. Turrets and hand-screw machines cause all sorts of mixups, both as to name and size. And numbers are often as meaningless as Sanskrit. The way some makers mix up designations with a mess of letters and numbers, with or without hyphens, makes it a real job to find out the capacity of a machine. Some makers use numbers indiscriminately and even their own salesmen can't tell you what a machine's capacity is without checking up on his list.

"Lathe and milling machine makers have made a stab at standardizing capacity by using similar numbers. But they stick in heavy and light, high speed and low, automatic and manufacturing until it makes you dizzy. Here again the word "auto-

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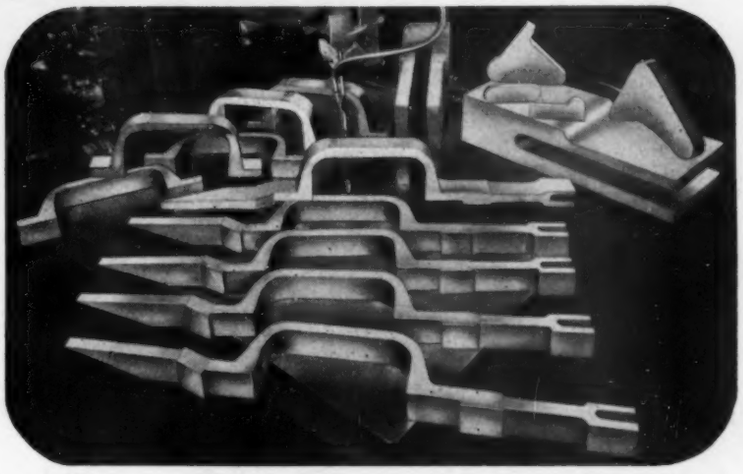

Taylor-Wilson Mfg. Co., McKees Rocks, Pa. had an important defense contract calling for forgings for large parts in the foreground. Dies would have cost lots of money. Making them by hand would have been slow and very expensive. The DoAll made the parts in 16 hours and this firm calculates that the saving was $600.

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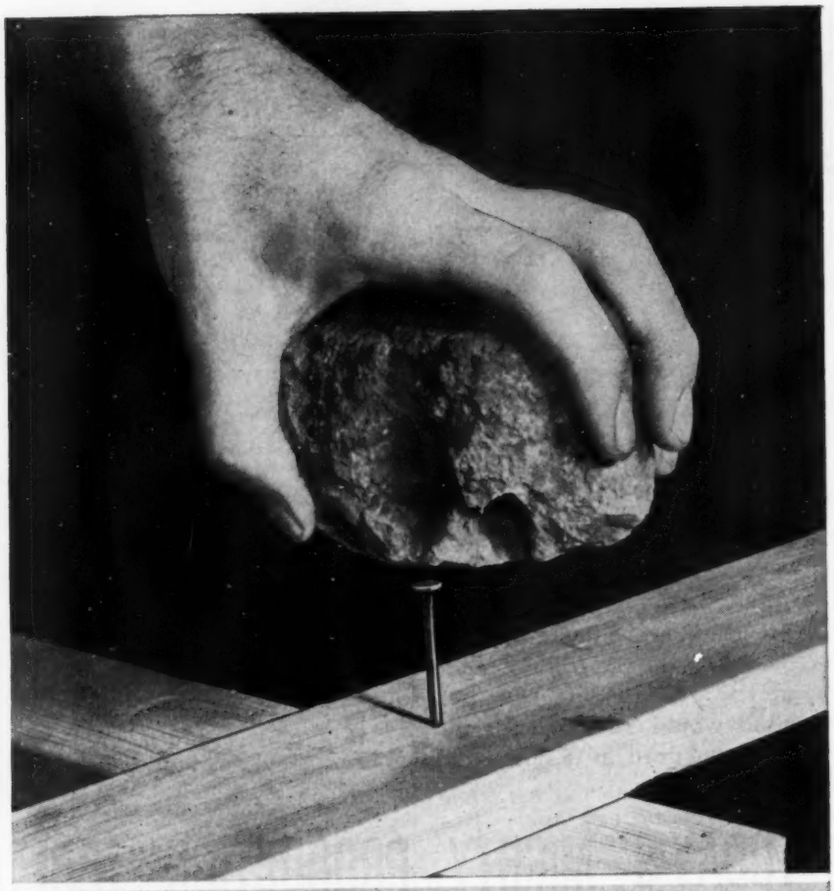

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it's a mighty slow and inefficient procedure—and so it is with taking measurements. You can use old fashioned tools and get results, but you can use the up-to-date Lufkin Precision Tools and get them more quickly, more easily and with greater assurance of accuracy. In every Lufkin tool you'll find several important details that make it possible for you to do your work better. For example, it's the two reading faces and rotating head in the Indicator, the unusual accuracy and ease of adjustment in the Micrometers, the five separate applications in the Radius Gages—and so on. Check these points for the tools you are interested in by referring to a copy of our complete Catalog which we'll gladly send on request.

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matic" may not mean the same thing on different machines.

"Milling machine classification used to be fairly simple with 'plain' and 'universal', 'horizontal' and 'vertical'. These were all knee type machines and we knew just what the terms meant. Now we have plain machines of the base or table type, with vertical adjustment of the spindle. It's a good machine, but why not give a distinct name, such as table or base type to distinguish from those with adjustable knees?

"Then we have makers of die-sinkers, jig borers and profilers! All vertical milling machines, usually of the table type. The same machine may be sold under all three names. And some of the machines that are listed as jig borers are a far cry from the old Swiss machine or the Pratt & Whitney which pioneered the 'measuring rod' type in this country. Of course we have all bored jigs on good horizontal and vertical milling machines, and on lathe face plates for years. But the real jig borer should hardly be mentioned in the same class.

"Planers and shapers get all tangled up in the minds of some who write the circulars and ads for those who build them. Shapers, since we had any, have had a horizontal ram carrying the tool over the work. The planer on the other hand holds the tool stationary on the crossrail and moves the work under it. But when they make a small machine of the open side variety, it becomes a shaper in the circulars. Some even call it a 'shaper-planer.'

"Slotters have vertical rams and have generally been used on large and comparatively rough work. So when they build them small for toolroom work, some give them "class" by calling them vertical shapers. Why not call shapers horizontal slotters by the same token.

"Drilling machine makers are also a bit confusing at times. Most of the radials now give you the swing of the arm and the diameter of the column, which are what you want. But builders of vertical column machines, that we used to call 'upright drills' are not agreed as to designating capacity. Some give the distance from spindle center to column, while others give double this, or 'swing', as we do in giving lathe capacity in this country. As long as we use this on lathes it might be more logical to use the same method in drilling machines. But center distance seems to give a little better picture to the eye. The main thing however is to have all makers use the same designation.

"All this may seem like a regular Johnson grouch to you, Godfrey, but it isn't. I've spent a lot of time showing people where a slotter isn't a shaper—and a jig borer isn't just a plain, not-too-good vertical miller. And the N.M.T.B.A. can do a real job when this emergency is over, by engineering a simple system of showing machine capacities.